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SELECTION AND TRAINING OF WATCHSTANDERS FOR COAST GUARD VESSEL TRAFFIC SERVICES

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16. Abstract

Based on operational manuals as well as observations and interviews during several visits to operating Coast Guard Vessel Traffic Service (VTS) centers, some basic problems in the selection and training of VTS watchstanders are identified and evaluated. Recommendations are made with regard to selection criteria and selection tests, and the evaluation of one potential selection test is presented. A training program, including both general preparation at a resident school and special training at the VTS site, is proposed. Progress in establishment of the resident course is reviewed, and guidelines are offered for the development and conduct of on-site training.

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PREFACE

The Behavioral Systems Branch of the Department of Transportation's Transportation Systems Center (TSC) is conducting a series of studies of watchstander performance at Coast Guard Vessel Traffic Services (VTSs). This report summarizes the principal efforts in Fiscal Year 1980, concentrating on the selection and training of VTS watchstanders.

Continued support and guidance were provided by L.B. Kelley and LT P.R. Corpuz at the Office of Research and Development and CDR I.S. Cruickshank of the Office of Marine Environment, Headquarters U.S. Coast Guard, as well as H.P. Bishop of TSC. The data base for analyses and conclusions was obtained through the willing cooperation of the Commanding Officers, staff, and watchstanders of the VTSs at Houston, TX, New Orleans, LA, San Francisco, CA, and Seattle WA. Special thanks are due to CAPT R.B. Mabrey, USCG Group New Orleans Medical Division Officer, for his advice on medical selection criteria. Significant aid in the preparation of this report was provided by the support staffs at TSC, Wilson-Hill, Inc., and Paradigm, Inc. For all of this assistance the authors are sincerely grateful.

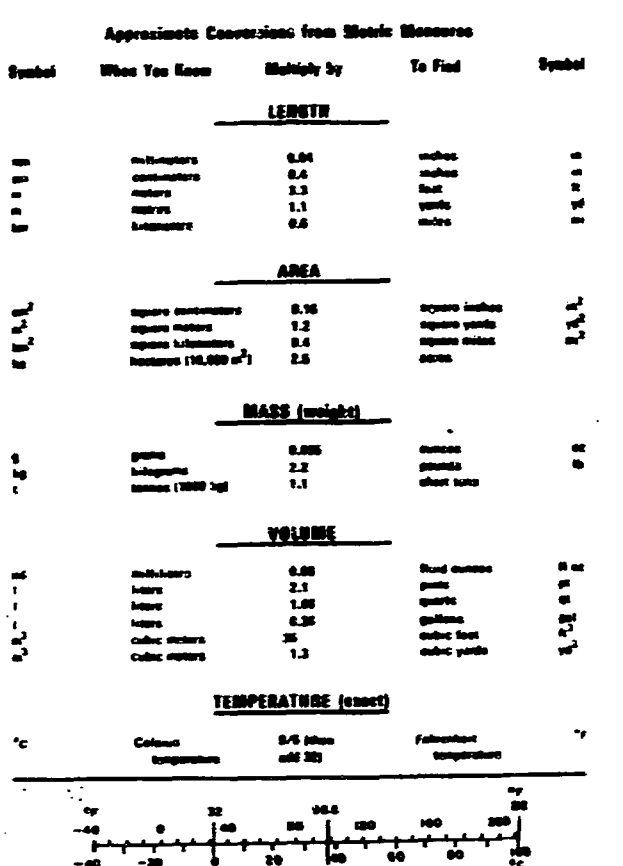
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
tbsp	tablespoons	15	milliliters	ml
in^3	cubic inches	16	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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THE STUDY

As part of a broader study of the performance of Coast Guard Vessel Traffic Service (VTS) watchstanders, the Transportation Systems Center (TSC) has investigated and evaluated current watchstander selection and training practices at VTSs. Initial visits to operating VTSs provided documented plans, programs and training materials and permitted TSC staff members to interview numerous watchstanders and VTS officers. After analysis of the initial data, follow-up visits were made to obtain updated and confirming data. In addition, an FAA selection test, the Multiplex Controller Aptitude Test (MCAT), was administered to 96 VTS watchstanders to evaluate its potential as a selection device.

PRINCIPAL FINDINGS

Current selection methods for VTS assignees permit the assignment of a few (about 9%) who cannot qualify to perform watchstander duties. These malassignees occupy precious VTS billets for up to a year before they can be detected, evaluated, and reassigned. About half of these malassignees could be screened out by a routine physical examination, a procedure that would be cost-beneficial and that is highly recommended. The MCAT shows promise as a means of detecting additional malassignees before assignment but will require modification and further evaluation before a decision can be made as to its use. Development of additional psychological selection tests cannot be justified on a cost-benefit basis.

All VTS watchstanders are qualified for duty through training conducted at the local VTS sites. Conducting this training encroaches on the duty time of the qualified watchstanders and may interfere with VTS operations. An analysis of the knowledge and skills that must be imparted to the trainees showed that a significant portion of the training could be handled more effectively at a pre-assignment resident schoold, where skilled, dedicated instructors with specialized training aids and facilities could provide all trainees with a common core of general knowledge and skills that would greatly reduce the time required for on-site specialized training. The Coast Guard accepted this evaluation and is currently in the process of establishing a resident training course for VTS watchstanders.

It is clearly understood that the final phases of instruction and practice for qualification as a watchstander at a given VTS still must be conducted on-site and that the local VTS staff must develop and conduct the training program. TSC, with the assistance of Wilson Hill Associates, Inc., and Paradigm, Inc., have developed guidelines that will help in planning and conducting on-site training and in preparing or acquiring effective training aids.

RECOMMENDATIONS

The following specific recommendations are offered:

a. Reject assignees for VTS duty who:

   1) Fail to meet physical fitness criteria,

   2) Have unsatisfactory service records, or

   3) Are strongly opposed to a VTS assignment.

b. Do not undertake the development and standardization of a battery of psychological selection tests for VTS duty.

c. Consider converting the MCAT to a Coast Guard format for use as an intial screening test.

d. Continue efforts to establish a VTS watchstander resident training course.

e. Promulgate formal guidelines for the conduct of on-site training. Use Section 3.8 of this report as a guide to the structure of an on-site training program; Section 3.5 for specification of course content; Section 3.6 for guidance on training methods, and Section 3.7 as a guide for training management.

1. INTRODUCTION

1.1 VTS WATCHSTANDER STUDIES

The United States Coast Guard (USCG) operates five Vessel Traffic Services (VTSs) located at San Francisco, CA, Seattle, WA, Houston-Galveston, TX, New Orleans, LA, and Valdez, AK. At each VTS, enlisted watchstanders operate a 24-hour watch over vessel traffic within their assigned VTS area, maintaining an up-to-date plot of traffic conditions, informing each vessel of anticipated traffic situations, and adding such cautionary or directive advice as the situation warrants. The purpose of this operation is to reduce the probability of vessel collisions, groundings and rammings by informing mariners, particularly vessel masters and pilots, of impending traffic and other hazards in time for the mariners to take appropriate actions for safe passage. Such services are expected to reduce shipping-related hazards to environment and safety.

Since the effectiveness of VTS operations is highly dependent on the performance of VTS watchstanders, the USCG Program Office, Office of Marine Development Environment and Systems (G-WWM-1), authorized the Office of Research and Development (G-DST-3) to manage a program of study of VTS watchstander performance. In turn, the Behavioral Systems Branch of the Department of Transportation's Transportation Systems Center (TSC) was commissioned to conduct the studies, beginning in the second half of Fiscal Year 1977 (FY77).

The ultimate objectives of this program are:

1) To develop models of VTS watchstander performance and effectiveness for use in analyzing and evaluating current operations and predicting future personnel and equipment needs,
2) To determine requirements and make appropriate recommendations on personnel selection and training, and
3) To employ research results as soon as they are developed to improve current operations and assure that future system designs are responsive to the needs of the people who must operate them.

This report documents the achievement of the second program objective. It integrates the results of several TSC efforts, principally:

1) An analysis of current policy, procedures, and requirements for selection and training of VTS watchstanders, based on data collected on-site during several visits to operating VTSs,
2) A field evaluation of the Multiplex Controller Aptitude Test, and
3) A contracted study of VTS requirements for on-the-job training

1.2 BACKGROUND

Criteria for selection and procedures for training VTS watchstanders evolved almost independently during the early days of operation of the first two VTSs (San Francisco and Puget Sound VTSs). These early practices were surveyed and analyzed as part of a VTS issue study, and recommendations for a selection and training program were included in the study report (Ref.1). These recommendations were approved by the Commandant, U.S. Coast Guard, and promulgated to give "...guidance

for the development, operation, and evaluation of vessel traffic management systems..." in March 1973. Since current practices appear to have been developed in accordance with these guidelines, the conclusions and recommendations of the issue study are reproduced in Appendix A.

1.3 ORGANIZATION OF REPORT

This report summarizes practices for selection and training of VTS watchstanders as of the time of vi its to the individual VTSs and offers recommendations for standardizing these practices to the extent that it seems desirable. In Section 2, problems associated with selection of VTS watchstanders are reviewed; the costs and benefits of more formal procedures are estimated; a field evaluation of the FAA's Multiplex Controller Aptitude Test as a device for selecting VTS watchstanders is summarized, and appropriate recommendations are offered for a program of watchstander selection. In Section 3, training practices at operating VTSs are reviewed; the basic elements of knowledge and skills necessary for effective VTS watchstander performance are identified; the benefits of a resident course and on-the-job training (OJT) are compared; the Coast Guard's efforts to develop a resident course are noted; guidelines for conducting OJT are developed, and appropriate recommendations are offered for a program of watchstander training.

2. SELECTION

2.1 THE PROBLEM

Generally, anyone qualified as a Quartermaster or Radarman (Grade E-3 or higher), with average or above average proficiency, and due for a shore assignment may be selected for assignment to watchstander duty at a VTS. Assignments of VTS watch officers are made from available full lieutenants with seagoing experience as Operations Officer on a high or medium endurance cutter, or as Commanding Officer of a patrol boat. Exigencies (such as lack of qualified candidates) may sometimes cause an exception to these rules.

The possibility of selecting persons for VTS assignment who cannot perform the VTS duties was recognized in the issue study: "It is important to recognize that occasionally some men may not make the grade, in which case they must be reassigned" (Ref. 1, p. 107). In the course of conversations with VTS staff during several visits to VTSs, TSC personnel heard about such assignees who, for one reason or another, could not qualify as duty watchstanders. Each VTS commander had been faced with the necessity of transferring one or more assignees. Although the numbers were small, the effects were serious.

Even one assignee who cannot be put on watch leaves a watch section short-handed. Since a person may be well into a training program before it becomes evident that he will not qualify; and since it takes a considerable period of time to decide that a transfer is necessary, to effect the transfer, to acquire a replacement, and to train a replacement, the watch complement remains short-handed for an extended period.

Even though a transfer is made without prejudice, the experience is unpleasant for the assignee; it may be perceived by him and others as a failure and, at best, it constitutes up to a year's set-back in career progression. All in all, the assignment of a person to VTS duty who is incapable of qualifying as a duty watchstander (to be referred to as a malassignment) is to be avoided if possible. It is desirable, then, to identify and screen out before assignment those persons who will not be able to qualify as VTS watchstanders.

2.2 THE SURVEY

In conjunction with a general follow-up of operations at Houston-Galveston, New Orleans, Puget Sound, and San Francisco VTSs, Commanding Officers, one former CO, Executive Officers, and some watch officers were interviewed to obtain more details on the scope and nature of the malassignment problem. A total of eighteen cases were identified as being disadvantageous to the VTS operation. Eleven of these assignees had subsequently been transferred and three were still on duty as "marginal" performers. Interviewees were unable to remember the disposition of the remaining four cases. Details of these cases are summarized in Table 1.

Exactly half (9) of these malassignments could have been easily avoided by pre-assignment screening. A routine medical checkup would have revealed the hearing and speech problems, and the examining officer could have easily detected and evaluated the language problem. One case involving side effects of medication and one with a history of psychiatric problems could have been detected from the individuals' medical records. At the time of the survey (late 1978 and early 1979), the problem of medical screening was already under study. TSC personnel conferred with Dr. R.B. Mabrey,

USCG Group New Orleans Medical Division Officer, and readily concurred with a set of physical requirements he had drafted for a pre-assignment medical evaluation. Subsequently, the Commanding Officer, CG VTS New Orleans, LA, forwarded these requirements entitled: "Physical Qualifications for Vessel Traffic Controllers" to Coast Guard Headquarters with a recommendation that they be considered for implementation. The recommendation was reviewed by the staff elements, but because of personnel shortages, it was decided that the recommendations could not be implemented at that time.

TABLE 1. MALASSIGNMENT CASES AT FOUR VTSs

REASONS FOR NEED FOR REASSIGNMENT			TRANSFER	
READILY DETECTABLE	PRIMARY	SECONDARY	YES	NO
Medical Record	2	2		
Hearing Defect	2	1		1
Speech Defect	1			1
Language Problem	1	1		
Assignment not Wanted	3	1	1	1
Subtotal	9	5	1	3
MORE DIFFICULT TO DETECT				
Not Mentally Alert	3	(1) 2		1
Perceptual Problems	3	(4) 1	2	
Idecisive	2	2		
Lack of Confidence	1	(3) 1		
Subtotal	9	6	2	1

Screening out persons who do not want the assignment can be done by asking the assignee if the assignment is acceptable. Personnel shortages may preclude making VTS a voluntary duty, but people strongly opposed to VTS duty will be poorly motivated and relatively ineffective watchstanders.

The other half of the malassignment cases would have been more difficult to anticipate before assignment. The three characterized as "not mentally alert" could not master the intricacies of VTS duty and had trouble communicating. An intelligence test might have identified them as potential problems, but their ratings suggest that the problem was not intelligence alone. Service records are reviewed before assignment; perhaps more stringent requirements for a good service record could be justified in view of the responsibilities associated with VTS duty.

Perceptual skills are essential for effective performance of VTS duty. A watchstander must not only create a mental map of the vessel traffic, but must also be able to project it into the future to predict the time and location of encounters. Many otherwise capable people lack this ability to visualize and project complex patterns; such persons could not function effectively as VTS watchstanders. There are standardized psychological tests of spatial and temporal perception. In fact, the Federal Aviation Administration has a standardized test of such skills that it uses for the selection of air traffic controllers, which will be discussed in more detail in Sections 2.3 and 2.4. Administration of such a test before assignment might have identified those seven persons who subsequently could not function effectively, mainly or partly, because of this lack of perceptual skills.

Indecisiveness and lack of confidence would be the most difficult factor to detect by pretesting. There will always be a few people whose inability to qualify will not become apparent until they have spent some time in training.

2.3 TEST DEVELOPMENT

2.3.1 Procedures

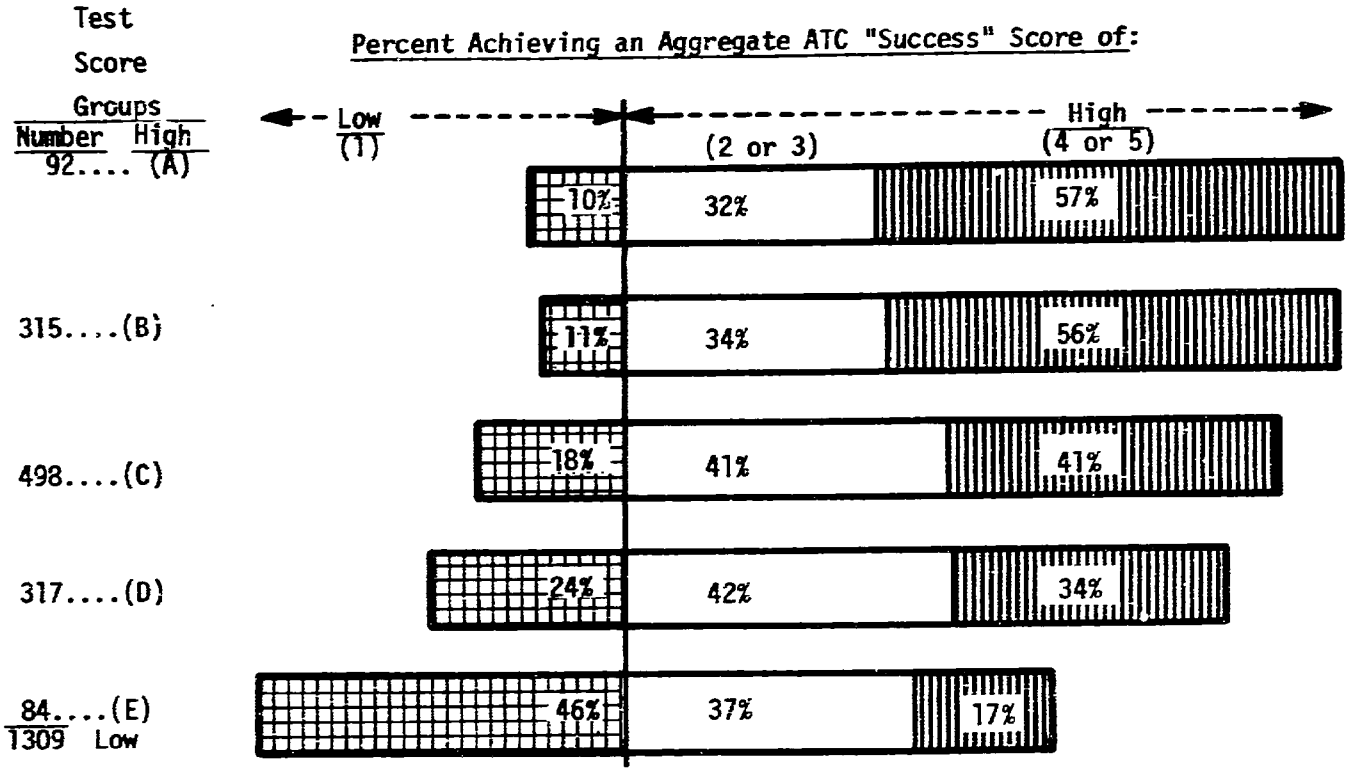
Medical examination and screening of service records pose no special problems; the means and facilities are at hand, and their application for pre-assignment elimination of malassignees requires only the establishment and enforcement of firm rejection criteria.

The development of psychological screening tests is more complicated, and involves expensive and time-consuming procedures with a substantial risk that the end product will not be very effective. Many test items must be selected. They must be administered to representative samples of the test population and their scores matched to independent measures of success and failure. In the VTS situation, the only known criterion group for rejection consists of 18 persons; most of them have been reassigned, or have left the service. To locate and test these people would be difficult if not impossible. It would be even more difficult to prove that the tests do not discriminate against minority groups -- a requirement of the Equal Employment Opportunity Coordinating Council.

2.3.2 FAA Tests

The experience of the Federal Aviation Administration (FAA) in standardizing tests for the selection of candidates for jobs as air traffic controllers (similar in many ways to VTC duties) is illuminating. The FAA has a long history of research and development in personnel testing and has recently adopted a test battery after extensive and rigorous evaluation (Miles, Colman and Domenech, Ref. 9). Figure 1 shows how well the scores on the test battery predict success as air traffic controllers

DISTRIBUTION OF TEST SCORE GROUPS WITHIN
THE AGGREGATE ATC "SUCCESS" CRITERION



From Mies et al, 1977.

FIGURE 1. EXPECTANCY CHART (REF. 9)

(as measured by supervisory ratings and job progression). In general, high scorers tend to be successful on the job; low scorers, unsuccessful. However, 11 percent of the highest scorers on the battery can be expected to be unsuccessful, and over half (54 percent) of the lowest scorers on the battery can still be expected to function effectively on the job. When large numbers of people must be screened for a large number of jobs, the degree of imprecision in this test battery is tolerable; the tests are valuable for the FAA situation. However, the high rejection rate of potentially good watchstanders in the lowest scoring group would be difficult to justify for VTS selection.

2.3.3 MCAT

Of the tests in the FAA battery, one single test provided a very high proportion of predictability. In fact, its score is given nearly five times as much weight as the next best test in predicting success as a controller at enroute traffic centers -- the job most like VTS duty (see Daily and Pickrel, Ref. 3). The test is called the Multiplex Controller Aptitude Test (MCAT). It is of particular interest because it tests basic abilities also required for VTS watchstanders, including perceptual skills.

The MCAT is a paper-and-pencil test that takes less than 45 minutes to administer. It presents pictures of a simplified air traffic situation (radar display) plus tables of data, and it requires the examinee to interpret the information to predict future encounters. Although it has an air traffic configuration, it is meant to be administered to people with no air-traffic control experience. The MCAT has been thoroughly evaluated. The concept (originated in 1960) was incorporated in several early studies, and was developed as a motion-picture test around 1970 (Buckly and Beebe, Ref. 2). The motion-picture test was converted first to a slide version and then

to a paper-and-pencil version during the period between 1971-1976 (Daily and Pickrel, Ref. 3). After further evaluation, the test was recommended for adoption by the Civil Service Commission in 1977 (Ref. 9). The MCAT history illustrates the long path of successive testing, revision, and retesting before a selection test can be adopted as a valid and reliable evaluator of a person's suitability for a job. It also establishes the MCAT as an available, authenticated measure of one of the qualities (perceptual skills) required for successful performance as a VTS watchstander.

2.4 EVALUATION OF THE MCAT

2.4.1 Introduction

Because of the success of the FAA in screening out unsuccessful air traffic controllers with the MCAT, and because VTS watchstanders seem to need some of the same perceptual skills as air traffic controllers, the possibility of using the MCAT to screen VTS candidates was considered. Validation of the test for VTS selection would have been virtually impossible at the time of the study due to lack of a criteria group (see 2.3.1 above). However, if the test could be shown to discriminate between good and poor watchstanders currently on VTS duty, there would be justification for pursuing it further. Therefore, a field study was undertaken that involved administering the MCAT to active VTS watchstanders and acquiring ratings of their competence to compare with the test scores.

2.4.2 MCAT

The MCAT was developed to measure specific aptitudes required by ATCs in a somewhat realistic format. The aptitudes measured include "direction following, table reading, interpretation of data, spatial visualization and orientation, estimation of distances and relative target movements, and arithmetic" (Ref. 3, p.2).

The final standardized MCAT has been adopted as an official Civil Service selection test and was not available for experimentation. Two experimental forms of the MCAT (equilivant to the official test) were used in this study. The first had 43 items and the second, 53. Each item had either two or four possible answers, only one of which was correct. Scoring was accomplished by counting the number correct and subtracting an error score (the number wrong divided by the number of possible choices).

2.4.3 Supervisor's Ratings

At each of the four vessel traffic centers a single knowledgeable supervisor was asked to rate each watchstander on 14 attributes related to job performance. A rating scale of 1 ("Among the Worst") to 7 ("Among the Best") was to be used. There were basically two categories of items on the form: those items which related directly to the aptitudes being measured by the MCAT (Items 4-8) and items related to other aspects of the job and overall performance (Items 9-14). Items 1-3 were dropped from the analysis because they either did not apply to all centers or were not relevant. A copy of the rating form is shown in Figure 2.

2.4.4 Procedure

The MCAT was administered to watchstanders at the Puget Sound, Houston-Galveston, New Orleans and San Francisco VTSs. In order to obtain a large sampling, each center was asked to administer the MCAT to as many of the watchstanders as possible without interfering with their scheduling. We received test results from 25 watchstanders at PSVTS, 15 at HGVTS, 36 at NOLAVTS, and 20 at SFVTS.

2.4.5 Results

Table 2 contains the mean and standard deviation for scores on the combined MCATs, the mean supervisor rating score, and each of the 11 rating items (Items 4-14). It can be seen that there was little difference in the mean scores on each of the rating items between centers but the mean MCAT score ranged from 60.97 at New Orleans to 68.53 at Houston-Galveston. Great care must be taken in interpreting the inter-VTS differences shown in Table 2 because the size of the samples vary greatly and, more importantly, testing conditions at the VTCs were not uniform or rigorously controlled.

In order to obtain a sense of what these MCAT scores mean, a rough comparison of the uncorrected scores of the VTS watchstanders with scores of enroute and terminal ATCs can be made. The mean score for the ATCs, taken from a study by Daily and Pickrel (Ref. 3) was about 75 for the combined score and the scores for NOLAVTS, SFVTS, HGVTS, and PSVTS were approximately 67, 68, 72, and 73 respectively.

Apparently, the aptitudes tapped by the MCAT for ATCs were not grossly different than those required for VTS watchstanders. The major relationship sought in the present study, however, is between the MCAT scores and supervisor ratings.

Daily and Pickrel report correlation coefficients[1] between MCAT scores and supervisor ratings for over 700 ATCs ranging from r =.075 for enroute ATCs

[1]The coefficient of correlation shows the degree of relationship between two sets of variables and ranges in value from 0 to +/-1.00. Statistical significance of the correlation is shown by the probability (p) that the value would have been obtained if the true correlation were zero.

CODE_____

WATCHSTANDER RATING FORM

1	2	3	4	5	6	7
Among the Worst	Very Bad	Poor	Average	Good	Excellent	Among the Best

ATTRIBUTES	RATING
1. Knowledge of VTS area geography	_____
2. Speed and accuracy of data entry	_____
3. Plotting accuracy (omit if computer is used)	_____
4. Time and distance estimation	_____
5. Predicting future vessel locations	_____
6. Predicting possible vessel conflicts	_____
7. Remembering vessel locations	_____
8. Remembering vessel intentions	_____
9. Understanding traffic status in order to relieve station	_____
10. Ability to deal with non-routine situations	_____
11. Radio-communication skills	_____
12. Confidence at job	_____
13. Attitude toward job	_____
14. Overall performance	_____

FIGURE 2. RATING FORM USED BY SUPERVISORS

(essentially no correlation) to r =.276 (p<.01). The overall correlation for various types of ATC jobs was .151 (p<.01). In a report by Mies, et.al.,(Ref. 4) it was found that an experimental test battery given to over 1200 ATC specialists correlated significantly with an aggregate measure of ATC "success" (r =.27, p<.01) and that the MCAT portion of the battery also was significantly correlated (r =.22, p<.01). In fact, the MCAT was the most significant single contributor to the effectiveness of the entire battery.

TABLE 2. MEANS AND STANDARD DEVIATIONS FOR SCORES ON MCAT AND SUPERVISOR RATINGS

	PSVTS N=25		HGVTS N=15		NOLAVTS N=36		SFVTS N=17	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
MCAT	66.76	12.72	68.53	12.35	60.97	13.97	61.95	17.11
ITEM 4	5.12	.93	5.47	1.13	5.00	1.10	5.53	1.18
ITEM 5	5.00	.96	5.47	.92	5.06	.95	5.41	1.37
ITEM 6	5.04	.98	5.67	1.18	5.03	1.16	5.29	1.45
ITEM 7	5.24	.97	5.47	.83	5.14	1.17	5.35	1.22
ITEM 8	5.24	.83	5.73	.80	5.14	1.20	5.41	1.18
ITEM 9	5.56	.96	5.53	.83	5.25	1.14	5.47	1.37
ITEM 10	5.12	1.20	5.33	1.23	4.86	1.22	5.00	1.37
ITEM 11	5.00	1.08	5.60	.91	5.03	1.32	5.53	1.12
ITEM 12	5.44	1.26	5.87	.83	5.14	1.38	5.94	1.03
ITEM 13	5.44	1.12	5.87	1.06	4.75	1.56	5.59	1.00
ITEM 14	5.20	.91	5.60	.91	5.06	1.19	5.65	1.11

The results from the present study show a correlation coefficient of .260 (p<.05) between scores on the MCAT and supervisor ratings. A scatter-plot for these scores is presented in Figure 3.

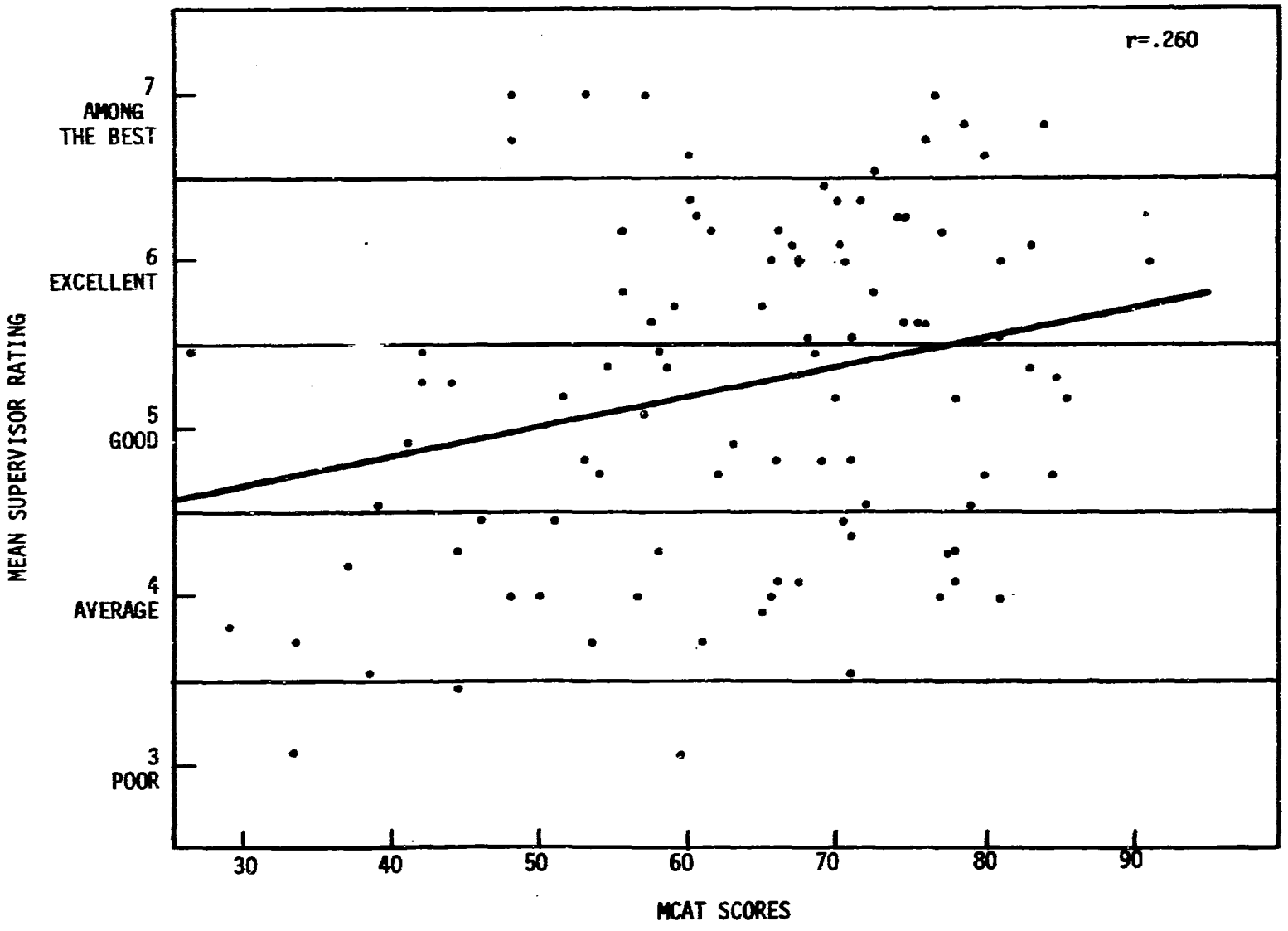


FIGURE 3. CORRELATION AND LINEAR REGRESSION LINE FOR SUPERVISOR RATINGS AND MCAT SCORES FOR NOLA, SF, PS, AND HG VTSs (N=93)

Since some of the items on the supervisor rating do not directly relate to the aptitude measured by the MCAT, an item by item correlational analysis was performed for each center separately and for the four centers combined.

Inspection of these correlations, presented in Table 3, reveals that neither the total supervisor rating scores nor any of the individual rating items were significantly correlated with MCAT scores for SFVTS, PSVTS or HGVTS. NOLAVTS results show that in addition to a significant overall correlation, Item 6 ("Predicting Possible Vessel Conflicts"), Item 8 ("Remembering Vessel Intentions"), Item 9 ("Understanding Traffic Status"), Item 12 ("Confidence at Job"), and Item 13 ("Attitude Toward Job") were significantly correlated with MCAT scores ($p<.05$). When all four VTSs are considered together, Item 4 ("Time and Distance Estimation") Item 5 (Predicting Future Vessel Locations), and Items 6, 8, 12, and 14 ("Overall Performance") are the significant items.

A few of the items which were not significantly correlated with the MCAT score were those related to attributes which were difficult, if not impossible for a supervisor to adequately evaluate. Item 7 ("Remembering Vessel Location") is not an ability which is specifically exhibited by watchstanders but requires the supervisor to infer it from other behavior. Items 10 ("Handling Non-Routine Situations"), 11 ("Radio-Communication Skills") are separate abilities which are not measured by the MCAT but are important in evaluating overall watchstander performance.

In the above discussion it was shown that the MCAT is significantly correlated with supervisor ratings of watchstanders' performance. The overall correlation was .260 ($p < .05$). The correlation obtained with the MCAT and ATC supervisor ratings

was .151 ($p < .01$). Although conditions of each test administration and the supervisor rating forms were quite different in these two cases, it appears as though the MCAT would be a better selection tool for VTS watchstanders than for ATCs. A close examination of the meaning of these results is warranted before making any judgments about the efficacy of the MCAT as a VTS watchstander selection technique.

TABLE 3. CORRELATIONS BETWEEN SUPERVISOR RATING ITEMS AND SCORES ON THE MCAT

	NOLAVTS	SFVTS	PSVTS	HGVTS	ALL VTS
ITEM 4	.261	.329	.154	.253	.249*
ITEM 5	.266	.299	.096	.090	.209*
ITEM 6	.431*	.187	.141	-.066	.245*
ITEM 7	.303	.086	.042	.016	.1[illegible]
ITEM 8	.333*	.163	.018	.001	.208*
ITEM 9	.385*	.009	-.176	.199	.158
ITEM 10	.292	.189	.029	.072	.197
ITEM 11	.299	.197	-.058	.236	.182
ITEM 12	.407*	.343	.067	.181	.279*
ITEM 13	.362*	.201	-.206	.055	.205*
ITEM 14	.247	.131	.040	.287	.182
MEAN	.371*	.210	-012	.141	.260*

* $p < .05$

In this study, four VTSs were sampled resulting in 93 MCAT/rating score pairs, 36 from NOLAVTS, 17 from SFVTS, 25 from PSVTS, and 15 from HGVTS. The only center to show a significant correlation was New Orleans. The nature of the significance tests applied to the correlations, however, takes into account the degree of the relationships of the two variables being compared and the size of the sample from which the measurements were taken. Therefore, when a correlation coefficient of .260 is found for the overall MCAT/rating relationship, an associated probability level of less than .05 means that the probability of a sample of this size reflecting a direct, positive relationship between MCAT scores and supervisor ratings when in fact there is no relationship is less than 5 percent.

Although these correlations are statistically significant they must be considered from a practical viewpoint. The square of the correlation coefficient is equivalent to the amount of variation in supervisor ratings which can be accounted for by scores on the MCAT. In this case it equals about 7 percent of the total possible variation. In other words, the spread of the data points around the regression line shown in Figure 3 represents variation due to variables other than MCAT scores.

Two final points need to be made concerning selection cutoff criteria and the population of potential watchstanders.

Figure 4 is a duplicate of Figure 3 with the addition of two hypothetical cutoffs or decision lines marked "Low" and "High". If it is important to select only the most qualified for watchstander training, as suggested by a high MCAT score, then the cutoff point for MCAT scores could be placed relatively high: say 75 (the line marked "High"). According to this criterion only those personnel with MCAT scores of 75 or

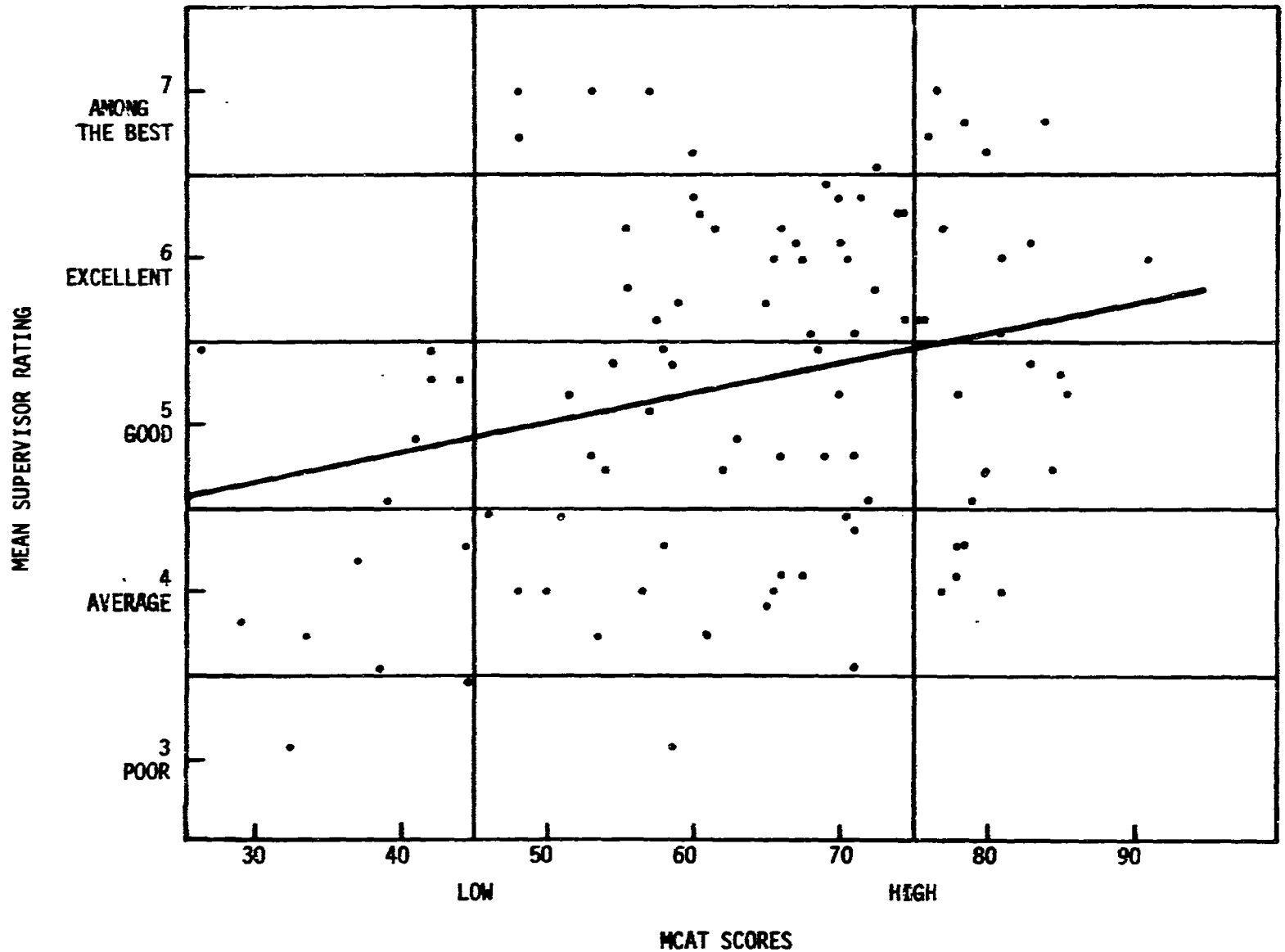


FIGURE 4. "HIGH" AND "LOW" CUTOFF CRITERIA FOR MCAT SCORES

higher would be selected for watchstanders. In this study that would have been 24 out of 93, or 26 percent.

If a "Low" criterion were used in order to eliminate only the lowest scores on the MCAT, and presumably the least likely to become good watchstanders, 12 of the 93 (13 percent) would be eliminated. Table 4 contains the precentage of this sample who would be selected ("High" criterion) or eliminated ("Low" criterion) and their supervisor ratings. None of the members of this sample with mean supervisor ratings of 6 or 7 would have been eliminated under the "Low" criterion and only 5 (5 percent of the total sample) with ratings of 4 or worse would have been accepted under the "High" criterion.

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On the face of it either criterion could be an acceptable one depending on whether one wishes to select only the most promising (the "High" criterion) or to eliminate only the least promising (the "Low" criterion). There are several problems with each approach, however.

TABLE 4. NUMBER AND PERCENTAGE OF SUBJECTS WHO WOULD BE ELIMINATED UNDER A "LOW", AND SELECTED UNDER A "HIGH" CUTOFF CRITERION

Supervisor Ratings	"Low" N=12 (12%)	"High" N=24 (26%)
7	------	5 - 21%
6	------	7 - 29%
5	6 - 50%	7 - 29%
4	5 - 42%	5 - 21%
3	1 - 8%	------

By using the "High" selection criteria it can be seen from Figure 4 that there would be a large number of "false negatives". In this sample, 28 (30 percent) of the watchstanders with ratings of "Excellent" or "Among the Best" would have been eliminated. In fact the three watchstanders with ratings of 7 on every item would have been eliminated.

Apart from the personal considerations of eliminating a potentially excellent watchstander from the opportunity of VTS duty, only with a labor pool of at least five times the number needed and otherwise qualified potential watchstanders can such a selection criterion be employed.

On the other hand, data from this study indicate that use of the "Low" criterion will result in six "false negatives" (i.e., with a supervisor rating of "Good") and a number of "false positives" ("false positives", only if a rating of "Average" is considered unacceptable; a dubious assumption). None of the "false negatives", however, received ratings of 6 or 7.

Before too much is made of these results it is important to remember that this MCAT testing was carried out with trained and, in the most part, highly skilled VTS watchstanders. Any natural selection and retention forces at work in the system have largely done their work. The personnel assigned to the VTSs who could not adequately perform the required duties have been reassigned, leaving the highly qualified and perhaps a few marginal watchstanders. If the supervisor ratings are examined (See Fig. 4) it can be seen that only one watchstander received a mean rating below "Average". By definition, one would expect most of the watchstanders to have received a rating of "Average" by their supervisor. In fact, one supervisor who was queried on this subject commented that the "Average" and lower ratings would have been applied to a few of the watchstanders who have since left the VTS.

2.4.6 Conclusions and Recommendations

In conclusion, it would appear that the MCAT does have some predicting validity for U.S. Coast Guard VTS watchstander "success". The correlation of about .3 with supervisor ratings, although statistically significant, may not be of much practical significance, however.

With the Coast Guard already short-handed in filling all billets, not only VTS, it does not seem feasible to use the "High" criterion approach to select only the most promising personnel. Use of the "Low" criterion, however, to exclude the lowest scorers on the MCAT (the lowest 15-20 percent) may turn out to be an acceptable approach. If something along these lines is considered important enough for further consideration, the following recommendations are offered:

1. Modify the test to more directly represent seagoing vessels rather than aircraft transits.

2. Perform more rigorous validation testing for the selection tool.

3. If this or another form of the MCAT is adopted, have the test administered to all Coast Guard enlistees at the time of their initial testing and training.

4. Under no circumstances should this or any another form of the MCAT be used as the sole or determining factor in the selection of VTS watchstanders.

2.5 BENEFITS AND COSTS OF A SELECTION PROGRAM

2.5.1 Benefits of Avoiding Malassignments

The major benefits of a selection program are the avoidance of malassignments and the savings of costs associated with having a billet occupied by someone who cannot perform the required duties. At every VTS visited, it was estimated that the combined time for detection, decision to transfer, and replacement of a malassignee amounted to a "lost" billet for one year. Assuming an average VTS complement of 25 enlisted watchstanders, at 1979 salaries and benefits, an average annual cost of 10,000 dollars per malassignment is estimated.

At the time of the survey, VTS's had been operating for a total of 207 operating months with an average complement of 23 persons. Assuming a complement turnover every 2 years, it can be estimated that up to the time of the survey, about 200 VTS assignments had been made. The 18 identified malassignees, then, amount to a 9 percent rate of malassignments.

With 6 operating VTS's and a 2-3 year turnover period, some 50-75 assignments can be expected per year in the near future, with 9 percent, or 4-7, annual malassignments. If these malassignees could be screened out before assignment, the

Coast Guard would then save 40,000 to 70,000 dollars annually. This benefit is conservative since no estimate has been made of the risks and costs of accidents cause by ineffective watchstander performance.

The survey showed that half of the malassignees could have been identified by a medical checkup and a review of the assignee's service record. Such screening, then has an estimated benefit of saving 20,000-35,000 dollars per year.

The FAA test battery can be used to obtain an optimistic estimate of the benefits to be derived from a well constructed and evaluated selection device. Table 5 has been constructed from Figure 1, in Section 2.3.2. It shows how many potential on-the-job failures and successes would be eliminated if all persons were rejected who scored below a given value on the selection battery. For example, if all applicants getting the lowest scores (level E) on the test battery were rejected, 16 percent of the potential on-the-job failures would be eliminated along with 4 percent of the potential successes. If people scoring in the two lowest categories (D and E) were rejected, nearly half of the likely failures would be screened out, but over a quarter of the "good" candidates would also be rejected. Raising the cutoff score another notch would get rid of 83 percent of the potential failures, but at a loss of two-thirds of the potential successes. In view of the small number of candidates the Coast Guard has available for selection, probably only the lowest cutoff score could be used. Therefore, if the Coast Guard could develop a battery of psychological selection tests as good as the FAA battery, this battery could be expected to identify 16 percent of the 2-4 malassignees not eliminated by the medical and records screening, or about 1-2 persons every 3 years. The expected benefit of psychological test development, then, is a savings of about 3,000-6,000 dollars per year.

The MCAT evaluation at VTSs showed some potential value of the test for selecting VTS watchstanders; test scores correlated with supervisor ratings at a level comparable with the FAA evaluations (2.4.5). Data are not detailed enough for a direct comparison of test score distributions between the FAA and VTS evaluations but suggest that the "Level E" cutoff score of Table 5 was slightly higher than the "Low" cutoff of Table 4.

TABLE 5. SELECTION OPTIONS AT VARIOUS REJECT SCORES

	Percent Rejected	
Reject Score	Likely Failures	Likely Successes
Level E	16	4
Levels D and E	47	27
Levels C, D and E	83	66

Since all the watchstanders evaluated were performing at a satisfactory level, they can be equated with the "Likely Successes" of Table 5. Thus, as described in this report, the MCAT would reject at least 12 percent of likely successes as compared to the FAA battery's rejection of 4 percent. Obviously, although showing promise, the MCAT requires additional revision to realize its potential. Rewriting the test items in terms of vessels rather than aircraft would increase the test's acceptability. But further administrations of the test over a broader range of examinees (such as Coast Guard recruits) is necessary before it can be used as a screening device.

2.5.2 Costs of Selection Methods

All Coast Guard personnel receive periodic medical examinations. The personnel and facilities are available; the only cost for medical screening of VTS candidates

would be that incurred by the extra examinations of those candidates who had not had a recent checkup. Service records are regularly reviewed before assignments are made; so that aspect of screening merely involves setting rejection criteria. Thus, the cost of medical and records screening is considered negligible.

The development of a standardized, fully approved battery of psychological tests, however is costly. The FAA battery used here as an example took at least two years to develop and cost over 200,000 dollars. Even assuming less test administration and evaluation in developing a Coast Guard battery, it would be unrealistic to drop the cost estimate below 100,000 dollars. Revision and additional testing of the MCAT could be done in-house to yield a less precise screening test at an estimated cost of 10,000 dollars.

2.5.3 Summary of Benefits and Costs

a. Routine medical testing and record screening would yield the Coast Guard an estimated benefit of 20,000-35,000 dollars per year at negligible cost.

b. Development and standardization of a battery of psychological selection tests would yield the Coast Guard an estimated benefit of 3,000-6,000 dollars per year at an estimated total cost of 100,000-200,000 dollars for test development and standardization.

c. Revision and testing of the MCAT as a screening test might yield a benefit of up to 5,000 dollars per year at at total cost of 10,000 dollars.

2.6 RECOMMENDATIONS FOR SELECTION

The results of the survey of malassignment problems and the review of FAA experience have led to the following recommendations:

a. Reject assignees for VTS duty who:

   1) Fail to meet basic physical fitness criteria

   2) Have unsatisfactory service records, or

   3) Are strongly opposed to VTS assignment.

b. Do not undertake the development and standardization of a battery of psychological selection tests for VTS duty.

c. Consider converting the MCAT to a Coast Guard format for use as an initial screening test.

3. TRAINING

3.1 INTRODUCTION

3.1.1 VTS Training Needs

Training is a planned and controlled process, following which a person (trainee) knows things (knowledge) and can do things (skills) that that person did not know and could not do previously. VTS watchstander duties are sufficiently complex that they cannot be performed safely and efficiently without some preparation. Therefore, all operating VTSs require that a person receive some kind of training before being considered qualified to perform the duties of a VTS watchstander.

Selection criteria for VTS duty do not include completion of any specific training courses. Therefore, all qualification training is accomplished on site - that is, mainly through on-the-job training (OJT). There are several disadvantages to on-site training:

a. It encroaches on the duty time of VTS personnel for planning, implementation, and supervision.

b. Operating personnel do not necessarily have the skills or the motivation for teaching.

c. Training activities may present a distraction or hazard to the extent that they interfere with on-going operations.

Certain local knowledge and skills can only be obtained on-site, and other information can be imparted most efficiently locally; OJT must be a part of any VTS qualification training program. However, it would be a benefit to operating VTS centers if assignees arrived with a common core of basic knowledge and skills. This

can be accomplished with a centralized-training facility (school) through which each assignee must pass prior to site assignment.

Centralized training would have a number of advantages -- for example:

a. Assurance of a common core of basic knowledge and skills

b. No interference with operations

c. Skilled and dedicated instructors

d. Efficient use of facilities and aids

e. Availability of special aids (e.g., simulators)

f. Reduced requirements for OJT

g. More rapid qualification for duty.

3.1.2 Purpose and Scope

The purpose of this section is to recommend a program for training VTS watchstanders that provides for both on-site training at VTCs and resident training at a Coast Guard school. The current status of VTS training is reviewed, and course content, course organization, and training methods are discussed. The details of course content for an on-site training program must be developed individually at each site. However, this section provides guidelines to assist the on-site training officer (or staff) in course development.

3.1.3 Sources of Information

In 1977 and 1978, Transportation Systems Center personnel conducted intensive studies of VTS watchstander duties and performance (See References 4, 5, 6, 7, 11). The detailed task analyses performed in these studies yielded initial lists of requisite knowledge and skills for performing VTS watchstander duties. These lists, refined

after review by Coast Guard operations and research personnel (including a review at each VTS), provided the foundation for the requirements given in Section 3.2.

In the course of these studies, information was also obtained on training procedures and training problems at four operating VTSs. Data collected included:

a. Records of interviews with VTS personnel on training matters

b. Copies of formal training programs and plans

c. Where available, copies of training materials (guidelines, notes, references, etc. prepared locally and given to trainees).

This information was combined at TSC to yield tentative descriptions of ongoing training at the VTSs. Informal updates of this information were made after several follow-up visits to the VTSs. In March and April, 1980, a more formal review of training was accomplished, including visits to Houston-Galveston and New Orleans VTSs and a mail survey of training at Puget Sound and San Francisco VTSs. The review of the status of on-site VTS training (Section 3.3), then, is current as of April 1980.

The Vessel Traffic Services Branch, GWWM-1, (then GWLE-2), of the Waterways Management Division at U.S. Coast Guard headquarters instituted a series of meetings in late 1979 and early 1980 exploring the possibility of establishing a resident VTS training course at a Coast Guard school. The minutes of these meetings constitute the basis for the summary of the status of resident training (Section 3.4).

3.2 KNOWLEDGE AND SKILLS REQUIRED

3.2.1 General Requirements

There are many items of knowledge and basic skills that any person, regardless of location of assignment, must possess in order to perform effectively as a VTS watchstander. These capabilities are important to identify, for they could be taught in a central school before a trainee is assigned to a site.

Table 6 lists those knowledge requirements that are most suitable for centralized training. Time spent teaching these subjects to a trainee would pay off in reduced time required for OJT at any location. The table specifies study of background documents that give direction and meaning to the specific VTS duties, as well as study of details of vessel operation, vessel types, traffic management technologies, and general VTS operations, which would prepare the trainee for more rapid adjustment to individual VTS operations.

Table 6 contains a provision for an introduction to basic support technologies. The intent is not to make the trainee an expert in these technologies, but simply to provide enough background in theory and application to give meaning to the duties involving use, adjustment, and simple maintenance of support equipment.

Table 7 lists some skills all VTS watchstanders should have in common that might as well be taught in a central school. Essentially, the skill level to be acquired there would constitute the first step in developing the detailed skills required on-site. Simulation of a generalized VTS would permit practice in basic communicating,

TABLE 6. GENERAL KNOWLEDGE REQUIREMENTS FOR VTS WATCHSTANDERS

Federal Laws and Regulations Governing VTS

- Ports and Waterways Safety Act of 1972
- International and Inland Rules of the Road
- FCC regulations
- Vessels bridge-to-bridge radiotelephone regulations
- Others

Basic Coast Guard Organization
Basic Seamanship
Basic Vessel Operations

- Dynamics of vessel maneuvering
- Bridge procedures
- Navigation and navigation aids

Vessels and Tows: Types and Characteristics

Vessel Traffic Management Techniques

- Traffic separation schemes
- Bridge-to-bridge radiotelephone procedures
- Vessel movement reporting system
- Radar, television, computer surveillance techniques

Nature of VTS Operations

- History
- Mission
- Responsibilities and liabilities
- General functions, positions and duties
- Location and types of active VTSs
- Cooperation with other agencies

Basic Support Technologies

- Radio (particulary VHF-FM)
- Radar
- Television
- Computers
- Other

Pilot Organizations and Operations
Safety, Accident Prevention, and Hazards
Basic Communications Procedures
Basic Surveillance Techniques
Basic Tracking and Plotting Techniques
Interpretation of Plots and Displays
Prediction of Traffic from Plots and Displays
Preparation and Delivery of Traffic Advisories
Responses to Incidents and Emergencies
Reporting and Record Keeping
Basic References and Other Sources of Information
Basic Public Relations

TABLE 7. GENERAL SKILL REQUIREMENTS FOR VTS WATCHSTANDERS

Reception and Recording of Vessel Reports

Plotting and Tracking Vessel Movements

- Manual plotting
- Dead reckoning
- Computer terminal operation

Interpretation of Traffic Displays

- Prediction of Encounters
- Prediction of Hazardous or special situations

Formulation and Delivery of Traffic Advisories

Communication Procedures, Inlcuding Monitoring in Noise

Operation and On-Line Maintenance of Equipment

- Communications
- Radar
- Television
- Computer terminals
- Tape recorders
- Other

Basic Preparation of Reports and Records

Selection and Use of Basic Reference Material

tracking, decision making, and record keeping. The level of simulation must be carefully determined in order to avoid overlearning of detailed skills that would have to be unlearned upon assignment to specific sites. A carefully prepared program, however, will develop skills that will readily transfer to the required site skills, thus speeding up the OJT phase of training.

3.2.2 Site-Specific Requirements

Table 8 lists those items of knowledge that require on-site training. The items include the mission and functions of the specific VTS, details of geography, industry and vessel traffic in the VTS area, and the facilities and procedures at the local VTS. This information could be imparted at a central school, but each trainee would have to learn all about every VTS -- an overwhelming mass of detail, most of which the trainee would never be required to use. Furthermore, the site-specific details would almost certainly have to be reviewed once the trainee arrived on site. Therefore, the knowledge summarized in Table 8 is considered best left for on-site training.

Finally, even with a basic core of knowledge and skill, and detailed knowledge of local operations, a trainee must be able to do the work of the VTS with some degree of proficiency before being considered qualified to stand watch. The skills that can best be attained through supervised practice at an operating VTS are listed in Table 9. Essentially, they build on the basic skills acquired in school, adding (throughpractice) proficiency in using the local facilities and equipment in accordance with local procedures to perform the specific duties a watchstander must perform at that VTS.

TABLE 8. SITE-SPECIFIC KNOWLEDGE REQUIREMENTS FOR VTS WATCHSTANDERS

Local VTS Mission and Responsibilities

Local Coast Guard Organization and Interfaces

Local VTS Operations

- Contents of VTS manuals and directives
- VTS positions: duties, responsibilities, and schedules
- VTS routine procedures (SOP)
- VTS special and emergency procedures (SOP)
- Assignments of VHF radio channels
- Requirements for reporting and record keeping

VTS Area

- Geography (waterways), including width and depth of channels
- Location of docks and anchorages
- Location of bridges, locks, etc., and their operating regulations
- Location of hazards to navigation
- Local tides, currents, weather, etc., and their effects on traffic
- Location of vessel movement reporting points
- TSSs, precautionary areas, and limited traffic areas
- Location and major products of local industries

Location and Nature of Support Radio, Radar and TV Sites

- Capabilities and limitations

VTS Area Traffic (including program of vessel rides)

- Types of vessel traffic and associated problems
- Ferry and excursion schedules
- Local laws, regulations and customs

Port Authority Organization

Pilots Associations and Operations

Shipping, Tug, Line Handling and Other Associations

Local Waterways Terminology, Jargon, and Accents

VTS Center Organization and Layout

- Equipment and facilities
- Sources of information
- Contacts and sources of support for incidents and emergencies

TABLE 9. SITE-SPECIFIC SKILL REQUIREMENTS FOR VTS WATCHSTANDERS

Reception and Recording of Vessel Reports

Data Entry (cards, models, computer inputs, as required locally)

Plotting and Tracking Traffic (as required locally)

- Preparation and maintenance of manual plot
- Dead reckoning
- Computer inputs
- Radar tracking

Monitoring Traffic

- Monitoring displays, plots, radar, TV, radio channels, etc.
- Integration of all information

Interpretation and Prediction of Traffic Situations

Preparation and Delivery of Advisories

Operation and On-Line Maintenance of Equipment

- Communications
- Radar
- Television
- Computer terminals
- Tape recorders
- Teleprinters
- Reproduction devices
- Other

Responding to Incidents and Emergencies

Preparation of Reports and Records

Location and Use of Reference Material

3.3 STATUS OF VTS TRAINING

3.3.1 Introduction

As of late 1980, all VTS training is conducted on-site. For convenience in later discussion, two phases of training will be identified. Phase I involves preliminary instruction and study, essentially covering the general and site-specific knowledge requirements. Phase II involves "hands on" experience, in which the trainee performs as a watchstander under supervision. Phase II covers the site-specific skill requirements through on-the-job training (OJT).

In the spring of 1980, Paradigm, Inc. under the immediate supervision of Wilson Hill Associates and the overall direction of TSC, reviewed the status of VTS training. Copies of formal training programs and written training materials were reviewed for four sites -- Houston-Galveston (HOU-GAL), New Orleans (NOLA), Puget Sound (PS), and San Francisco (SF). In addition, visits were made to HOU-GAL and NOLA where officers and enlisted personnel were interviewed at length on current training programs and perceived needs. In these interviews, information on the training program for both watch officers and watchstanders was obtained both from the trainees and their trainers.

The training programs have been continuously updated at these VTSs. Indeed, at the time the data were collected, HOU-GAL had just completed extensive program revision and SF was in the process of thoroughly revising their program. Hence, the current training programs discussed in this report differ to some extent from those described in previous TSC reports. Furthermore, the written materials obtained from Puget Sound and San Francisco pertained only to the initial orientation program and

not to OJT. As a result, and since site visits to PS and SF were not made, these data in this report are based on only the orientation portion of the training program at these two sites.

3.3.2 General Program Structure

There are three training programs at Houston-Galveston and New Orleans: a program for new recruits, a requalification training program for experienced watchstanders, and a program for watch officer training. Except for requalification training, the programs at these two VTSs are very similar.

3.3.3 Training for New Recruits

The training program for new recruits at both HOU-GAL and NOLA consists of an orientation period followed by on-the-job training (OJT). The orientation period is short (6 weeks in Houston-Galveston; 3 weeks in New Orleans) compared with OJT. On-the-job training is considerably longer at both sites; an average of four to five months, with each trainee proceeding at his own pace. In all, it generally takes up to six months for a watchstander to become fully proficient. On occasion, some trainees fail to qualify at all.

The orientation period is a relatively structured program with a schedule of required activities. By contrast, OJT is a comparatively unstructured program in which trainees are assigned to experienced watchstanders who are expected to teach them the job.

Both VTSs also require each trainee to experience riding on the bridges of various vessels within the system. (It should be noted that vessel rides are required

not only during qualification training but throughout the watchstander's tour of duty.) Prior to training, new recruits are given a brief tour of the facilities. This tour is not considered to be part of the training program.

At both VTSs, written tests of knowledge are given almost every week during the initial training phase, and a comprehensive written test is administered at the end of this period. Both also use performance checklists for assessing acquisition of skills during OJT and for a final proficiency rating at the end of training.

Phase I, the orientation training, is conducted primarily by a chief petty officer. Most of the knowledge training and some skill training occurs during this period. The trainees receive information on the VTS organization and operation, on basic seamanship, and on VTS traffic. They also begin the process of memorizing the waterway. This is followed by a study of information regarding each piece of equipment, and on operating procedures for that piece of equipment. Additionally, both VTSs provide hands-on training on the equipment, although NOLA offers more extensive skill practice during the orientation period than does HOU-GAL.

Phase II, OJT, consists of hands-on training conducted by experienced watchstanders who are supervised by the watch officer. Trainees are trained on one sector in the operations center at a time. They receive instruction from a number of watchstanders; most qualified watchstanders serve as trainers. Initially, the trainees observe an experienced watchstander at work and listen to his advisories. The watchstander-trainer shows the trainee how to do the job, explaining the process whenever possible, and allows the trainee to perform portions of the task. The trainees are given more and more responsibility, while being closely supervised by watchstander-trainers, until they perform the entire job. OJT continues until the trainee is certified as being fully qualified on each of the sectors by his superiors.

3.3.4 Requalification Training for Watchstanders

At HOU-GAL, the watchstanders are required to take two channel rides and written tests of knowledge every six months. At NOLA, the training officer keeps a personnel log on each individual's performance. Any problems are discussed with the individual. The watchstanders are also expected to take one channel ride each quarter.

3.3.5 Watch Officer Training

Training for watch officers is somewhat less structured than for watchstanders. Watch officers receive watchstander training at an accelerated pace for the first several weeks. They are given additional required reading, and receive OJT from an experience watch officer. Qualified watch officers are expected to stay abreast of changes in VTS operations and are required to take vessel rides periodically.

3.3.6 Program Content

In general, the content of the current training programs for new watchstander recruits at HOU-GAL, NOLA, PS and SF include information on the VTS organization and operations, data on the waterway's geography and traffic, information on basic seamanship, and knowledge and skill and training on the equipment. Within these broad categories, however, the specific content differs from one VTS to another. It should be noted that the content of these programs will necessarily differ because specific characteristics of the waterways and of the VTSs vary considerably.

The content of these programs is outlined in Table 10. The data shown are as of Spring, 1980, when Paradigm personnel visited the sites and reviewed the training

TABLE 10. CONTENT OF EXISTING TRAINING PROGRAMS FOR WATCHSTANDER RECRUITS AT FOUR SITES

	HOU-GAL	NOLA	PS	SF
Introduction to VTS:				
• VTS history and purpose				X
• VTS organization and operations				X
Local VTS Organization and Operations:				
• VTS mission and responsibilities	X	X	X	X
• VTS organization and operation	X	X	X	X
• VTS policies and procedures	X	X	X	
• Laws, rules and regulations governing VTS	X	X	X	X
• Coast Guard area commands and interfaces	X	X	X	X
Waterway:				
• Geography of the waterway	X	X	X	X
• Local industries and facilities	X	X		X
• Local waterway laws, regulations and customs		X	X	X
• Traffic Separation Scheme	NA	NA	X	X
• Traffic lights	NA	X	NA	NA

NA = Not Applicable

TABLE 10 (CONT'D)

	HOU-GAL	NOLA	PS	SF
Traffic:				
• Channel/port operations, local traffic and marine associations	X	X		X
• VTS user (vessel) characteristics	X			?
Seamanship:				
• Applicable rules of the road	X	X	X	?
• Basic shiphandling	X	X	X	
• Light list		X	X	
Communications:				
• System and equipment	X	X	X	X
• Operating procedures	X	X	X	X
• Bridge-to-bridge radio telephone communications	X	X	X	X
• Local terminology		X		
• Interpretation	?	?	?	?

NA = not applicable.

? = training in area possibly provided but undocumented.

TABLE 10 (CONT'D)

	HOU-GAL	NOLA	PS	SF
Vessel data cards	X	NA	X	?
Plotting Board:				
• System and equipment	X	NA	X	NA
• Operating procedures	X	NA	X	NA
• Interpretation	?	NA	?	NA
Computer:				
• System and equipment	X	X	NA	NA
• Operating procedures	X	X	NA	NA
• Interpretation of display	?	?	NA	NA
Radar:				
• System and equipment	X	NA	X	X
• Operating procedures	X	NA	X	X
• Preventive maintenance		NA	?	?
• Interpretation of display		NA	?	?
CCTV:				
• System and equipment	X	NA	NA	NA
• Operating procedures	X	NA	NA	NA
• Interpretation of display	?	NA	NA	NA
Predicting vessel location	X		X	

NA = not applicable.

? = training in area possibly provided but undocumented.

TABLE 10 (CONT'D)

	HOU-GAL	NOLA	PS	SF
Supplementary equipment:				
• System and equipment	NA	NA	X	X
• Operating procedures	NA	NA	X	X
Forms, reports, message handling procedures	X	X		
Safety and security procedures	X	X		X
Standard references			X	

NA = not applicable.

plans and materials. An "X" entry for a topic indicates that the subject is specifically included in the training program. A blank indicates the subject is not explicitly taught, although the watchstander may learn that particular knowledge or skill through experience. Data for Puget Sound and San Francisco were obtained primarily from reviewing the printed materials from those locations.

The configuration and order of the topics presented in Table 10 do not necessarily correspond to that of the individual VTSs. The material has been arranged in the categories and order presented for purposes of comparison and discussion. As mentioned above, the content of these programs within the subject categories differs to some extent among the VTSs. Accordingly, the table suggests more uniformity among the programs than actually exists.

A comparison of the topics included in these training programs with knowledge and skills required by the watchstander job indicates that the correspondence is quite high. Certain important subjects are missing, however, or inadequately dealt with. These are primarily cognitive skills which are, by their very nature, more difficult to incorporate in a training program or to learn.

3.4 PROPOSED RESIDENT TRAINING COURSE

3.4.1 Proposed Total Training Program

The advantages of pretraining VTS watchstanders at a central school before assignment to a VTS site have been noted (Section 3.1.1). The analysis of general versus site-specific training requirements (Section 3.2) showed how a total training

program might be divided into central and on-site parts. This division is illustrated in Figure 5.

Figure 5 shows two alternative training processes (present and proposed) for progressing from an initial assignment of VTS duty to qualification to go on-line as a watchstander at an operating VTS. The present path encompasses all training at the VTS site; the proposed path sends the trainee to a Coast Guard resident school to learn general knowledge and skills, then to the VTS for training on site-specific knowledge and skills. The advantages of the proposed path lie mainly in the reduced amount of time and effort needed to get an assignee qualified after arrival at the VTS. First, the assignee will arrive on-site with the requisite general knowledge, reducing Phase I training requirements to site-specific knowledge only. Second, the general skills learned in the resident course will permit the trainee to pick up the site-specific skills in Phase II in considerably less time. Therefore, the establishment of a resident course for pretraining VTS assignees is highly recommended.

3.4.2 Status of Proposed Resident Course

The Coast Guard has already accepted the concept of a resident course. In July, 1979, the Office of Research and Development (G-DST) established liaison with the Office of Personnel (G-PTE) to initiate planning for such a course. A series of planning meetings with the VTS program office (G-WWM) resulted in the formal launching of an effort to establish a course.

The steps required to establish a new course are spelled out in the Coast Guard's Commandant Instruction 1550.8A (29 Dec 1977): "Resident Training Course Curricula

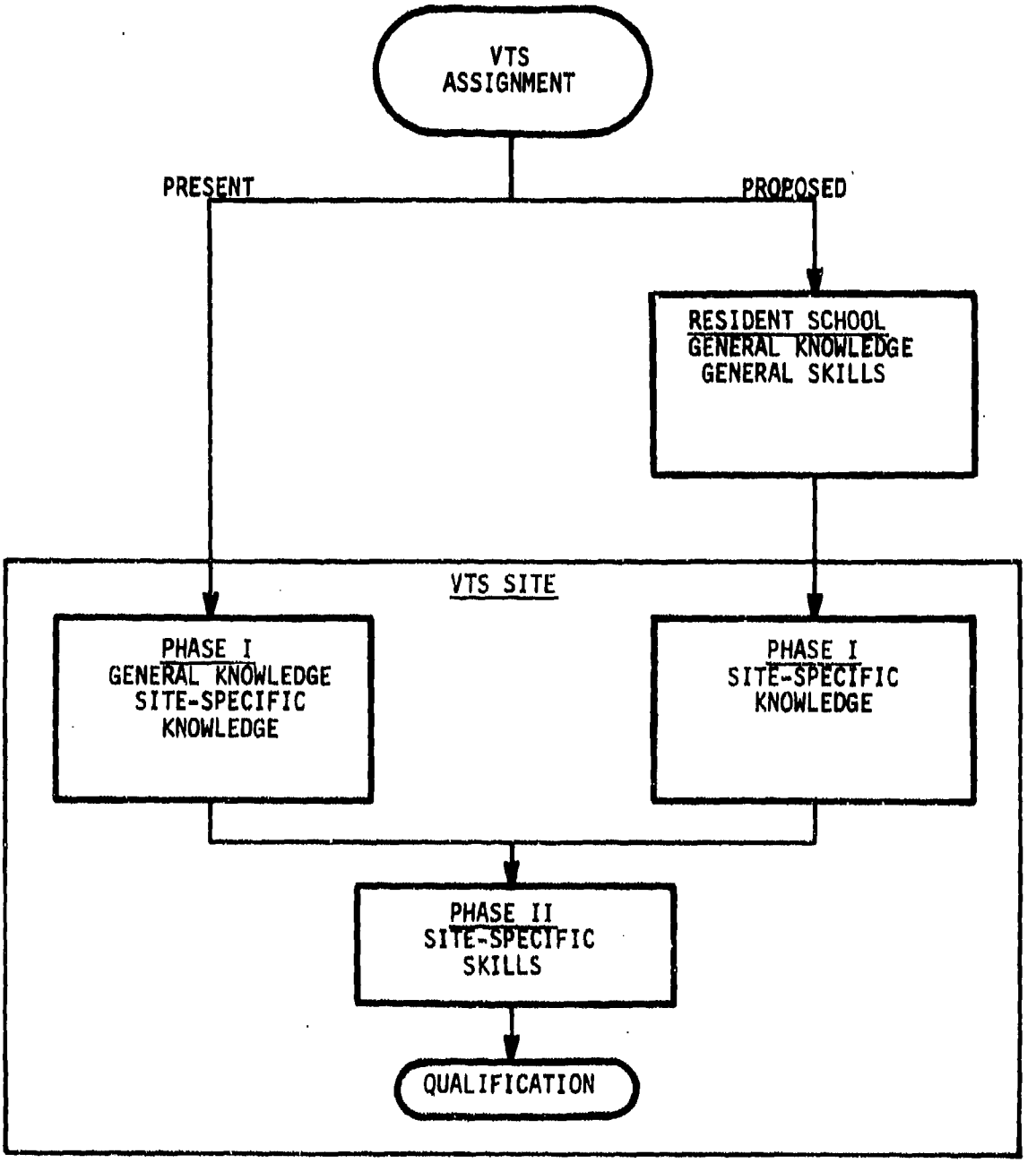

FIGURE 5. ALTERNATIVE PATHS TO QUALIFICATION

and Resources; Management of;" paragraph 3a of Enclosure (2) of this document, reproduced in Figure 6. The request and problem statement were submitted by G-WWM to G-PTE on 17 Jan 1980, and a satisfactory task inventory was developed the same month. The forwarding of course criteria to the appropriate training source for action, step 3a(2), requires authorized funding, which G-PTE has requested. Accomplishment of the remaining steps cannot be completed until sometime in Fiscal Year 1983 (projected as of September, 1980).

3.5 RECOMMENDED CONTENTS FOR ON-SITE TRAINING

3.5.1 Introduction

Despite its desirability, the institution and operation of a resident school for preliminary VTS training will not take place in the near future (Section 3.4.2). In the meantime, watchstanders must continue to be qualified wholly through on-site training. Furthermore, it is likely that, even when a resident course is instituted, quota and availability problems may still require some training to be done wholly on-site. It is therefore desirable to develop guidelines for planning and conducting an on-site program (the "present" path of Figure 5).

Although the details of an on-site training program can be specified only at the site, the nature of the contents and methods involved can be described in a format that might be utilized as guidelines at every site. In the balance of Section 3.5, such a format will be presented; subjects currently covered at the VTSs will be described briefly; recommended new subjects will be discussed in more detail, and the needs for requalification and for watch officer training will be noted. Section 3.6 will discuss some training methods of particular value, and Section 3.7 will provide guidelines for managing an on-site training program.

3. Procedures

a. New Curriculum - Proposals for new training courses may come from any individual in the Coast Guard. Proposals for new training are evaluated by the Commandant. The expressed need for a course shall be accompanied by a problem statement with substantiating evidence. If it is determined that a sufficient need for the training exists, the following procedure shall be used:

1) SME formulates course mission, scope, and terminal performance skill and knowledge objectives

2) Commandant (G-PTE) reviews and forwards these criteria to the appropriate training source for action.

3) The training source develops a curriculum outline similar to the sample outline contained in enclosure (3) and articulates resource needs to the Commandant (G-PTE).

4) The curriculum outline is reviewed by Commandant (G-PTE) and the SME, revised as necessary and approved. Commandant (G-PTE) determines if required resources are available and procures necessary resources where possible.

5) The training source then develops lesson plans and proposes a course convening schedule.

6) Commandant (G-PTE) approves the schedule, advertises the course, and issues quotas.

FIGURE 6. PROCEDURE FOR ESTABLISHING A TRAINING COURSE (From Enclosure (2) to Coast Guard Commandant Instruction 1550.8A 29 December 1977.)

NOTE: SME = Subject Matter Expert

3.5.2 Overview of Course Contents

Table 11 summarizes the contents of a recommended program for on-site training of VTS watchstanders. Each subject is identified as involving knowledge (K) or skills (S) or both. If a subject is not applicable at all VTSs, an asterisx (*) is used to indicate: "Where Applicable." The table also indicates during what phase of training -- Phase I (orientation) or Phase II (OJT) -- the subject should be included. As discussed in more detail in section 3.7.3, for all subjects listed, virtually all basic information and as much skill training and practice as possible should be included in Phase I.

3.5.3 Subjects Currently Taught

Listed immediately below are some of the subjects which are presently part of one or more training programs. Those subjects listed in Table 11 whose content is obvious from the title are not detailed below. In Section 3.5.4 recommended new and expanded subjects will be discussed in greater depth.

a. VTS history and purpose -- includes a brief narrative of events leading to the first VTS and the general purpose of VTS.

b. VTS organizations and operations -- includes the place of VTS in the Coast Guard, location and status of other VTSs, and an overview of vessel traffic management techniques, e.g., traffic separation schemes, vessel movement reporting systems, and methods for plotting, predicting, advising and surveillance.

c. Local VTS mission and responsibilities -- includes such items as history of the local VTS, purpose and services provided and area of coverage.

d. Local organization and operation -- includes such items as chain of command, position responsibilities and duties, watch schedule, and types of equipment employed.

TABLE 11. RECOMMENDED SUBJECT AREAS FOR A VTS WATCHSTANDER TRAINING PROGRAM

	Phase I	Phase II
Introduction to VTS:		
• VTS history and purpose (K)	X	
• VTS organization and operations (K)	X	
Local VTS Organization and Operations:		
• Local VTS mission and responsibilities (K)	X	
• Local VTS organization and operations (K)	X	
• Local VTS policies and procedures (K)	X	
• Applicable laws, rules and regulations governing VTS (K)	X	
• Coast Guard area commands and interfaces (K)	X	
Waterway:		
• Geography of the waterway (K)	X	
• Local industries and facilities (K)	X	
• Local waterway laws, regulations and customs (K)	X	
• Traffic Separation Scheme* (K)	X	
• Traffic lights* (K)	X	

*Where applicable.

K = knowledge.

TABLE 11(CONT'D)

	Phase I	Phase II
Traffic:		
• Channel/port operations, local traffic and marine associations (K)	X	
• VTS user (vessels) characteristics (K)	X	
Seamanship:		
• Applicable rules of the road (K)	X	
• Basic shiphandling (K)	X	
Communications:		
• System and equipment (K&S)	X	X
• Operating procedures for VTS radio (K&S)	X	X
• Bridge-to-bridge radio telephone procedures (K)	X	
• Local terminology and accents (K)	X	
• Interpretation (K&S)	X	X
Vessel data cards:*		
• System and equipment (K&S)	X	X
• Operating procedures (K&S)	X	X
Plotting board:*		
• System and equipment (K&S)	X	X
• Operating procedures (K&S)	X	X
• Interpretation of display (K&S)	X	X

*Where applicable.

K = knowledge.

S = skills.

TABLE 11 (CONT'D)

	Phase I	Phase II
Computer:*		
• System and equipment (K&S)	X	X
• Operating procedures (K&S)	X	X
• Interpretation of display (K&S)	X	X
Radar:*		
• System and equipment (K&S)	X	X
• Operating procedures (K&S)	X	X
• Interpretation of display (for non-radarmen) (K&S)	X	X
CCTV:*		
• System and equipment (K&S)	X	X
• Operating procedures (K&S)	X	X
• Interpretation of display (K&S)	X	X
Integration and prediction:		
• Integration of information from available data sources (K&S)	X	X
• Predicting vessel location (K&S)	X	X
Incidents and Emergencies:		
• Recognition (K)	X	X
• Response (K&S)	X	X

*Where applicable.

K = knowledge.

S = skills.

TABLE 11 (CONT'D)

	Phase I	Phase II
Standing Operating Procedure (SOP):		
• Introduction (K)	X	
• Routine SOP (K&S)	X	X
• SOP for emergencies and unusual events (K&S)	X	X
Supplementary equipment:		
• System and equipment (K&S)	X	
• Operating procedures (K&S)	X	
Preventive maintenance of equipment (K&S)	X	X
Forms, reports, message handling procedure (K&S)	X	X
Safety and security procedures (K)	X	
Standard references (K&S)	X	X

*Where applicable.

K = knowledge.

S = skills.

e. Local VTS policies and procedures -- includes VTS routine procedures.

f. Applicable laws, rules and regulations governing VTS -- included here are the Ports and Waterways Safety Act of 1972 and bridge-to-bridge radiotelephone regulations.

g. Coast Guard area commands and other interfaces -- includes Captain of the Port and other local Coast Guard and Navy units.

h. Geography of the waterway -- includes all items pertaining to the waterway itself, such as points of entry into the system and reporting points, geographical points and bends, anchorages, ferry crossings, tides and currents, local weather problems, etc.

i. Local industries and facilities -- includes such items as names and locations of facilities and docks along the waterway, the nature of the businesses and types of cargo.

j. Channel/port operations, local traffic and marine associations -- includes information on pilot associations and on dredging, mooring, bunkering, ferry, tug and tow boat operations.

k. Communications system and equipment -- includes information on remote communications sites, operating frequencies, equipment operation and controls.

l. Operating procedures for VTS radio -- includes requirements for content of transmission to/from vessels.

m. Plotting board operating procedures -- includes dead reckoning vessel position and moving vessel cards.

n. Computer system and equipment -- includes equipment operation and controls, keyboard functions, points on display.

o. Computer operating procedure -- primarily includes data entry and retrieval procedures.

p. Radar system and operation -- includes basic radar concepts, remote sites, equipment operation and controls, and the display.

q. Supplementary equipment - includes all equipment used in the VTS operations that is not mentioned above such as multi-channel tape recorder, photocopy machines, etc.

r. Preventive maintenance of equipment -- includes maintenance tasks and procedures required for watchstanders.

s. Standard references -- includes names and contents of references, and their location in the VTS.

3.5.4 New Topics

The subjects not now taught and recommended for inclusion in training programs for new watchstander recruits include:

a. Communication comprehension

b. Interpretation of displays

c. Integration of available data and prediction of vessel location

d. Recognition of and response to hazardous situations

e. Standing Operating Procedure (SOP).

3.5.4.1 Communication Comprehension - At certain sites -- most notably New Orleans -- simply understanding the local accents and terminology needs to be learned. New Orleans includes in its written materials a list of terms commonly used on the river. NOLA should consider adding to its program structured practice to assist watchstanders in recognizing local terminology when they hear it. This could consist of having trainees listen to actual tapes of vessel reports, having them record the pertinent information and checking their answers with hard copy of the communications.

3.5.4.2 Interpretation of Displays - As has been previously reported by TSC (Ref. 7) and as experienced watchstanders well know, each type of primary equipment available has its advantages and disadvantages under certain conditions. For example, vessel reports are an integral part of the traffic management system. However, user's radio reports can be in error, and computer or manual plots based on those reports will be in error accordingly. Radar is accurate, precise, independent of time of day, relatively independent of weather, and provides a wide area of coverage. It also is susceptible to ground clutter, and interpretation of radar imagery requires special training. Closed circuit television presents a familiar, realistic display. However, TV's range is restricted and visibility is reduced by fog and precipitation.

It is recommended that information on the assets and limitations of the displays (which is common knowledge among experienced watchstanders) be specified in writing and included in the training program for new watchstanders. Minimally, this lesson would include:

a. The primary utility of each piece of equipment.

b. The circumstances which reduce the utility of each piece of equipment.

c. Rank order in terms of usefulness of the types of equipment under each set of circumstances.

This information could be presented in the orientation period; supervised practice using this information could be carried out in OJT.

3.5.4.3 Integration - Integration of traffic information involves piecing together the clues available from various information sources to create a coherent picture of the traffic situation. When numerous sources of information are available, integration

may involve the creation of a model from some of the information using the balance of the information to check and verify the model. When different sources disagree in their indications, the watchstander must decide which sources to believe (see Section 3.5.4.2). When several data sources are available, particularly when there is a computer-generated plot, watchstanders may use only the data easiest to obtain. For example, they may give advisories from the computer displays without checking them against radar or messages overheard on the bridge-to-bridge radio. Since this practice could lead to erroneous advisories which could contribute to accidents, trainees should be taught to attend to and integrate the sometimes conflicting data from available sources.

The amount of information available for plotting vessel traffic movement varies considerably among the VTSs, depending upon the number and types of data sources available. Watchstanders at Houston-Galveston combine data from the radio, computer, and radar or TV to formulate an advisory. Watchstanders at Puget Sound and San Francisco combine data from the radio, radar and manual plot. Since there is no surveillance equipment at NOLA, there is less information to integrate at that center and more dependence must be put on data obtained from the radio.

At present, this integration process is not taught; the watchstander learns this skill through experience. Before this process can be incorporated in the training curriculum, it must be explicated. At this point in time, it appears that this process is not well understood. It can be assumed that there is at least one (and there may be several) good methods of integration. The first step could be to explore how watchstanders mentally combine the data. One possible method of collecting this kind of information would be to observe a number of experienced (and articulate)

watchstanders from beginning to end of the process of combining data for an advisory. Immediately after the advisory is given, the watchstanders would be asked to describe what they did mentally to determine the plot. Analysis of the observational and self-report data would be used to explain the process.

After this model (or models) for integrating the data is developed, the procedure could be required and a lesson to teach these skills could be designed and included in the orientation training period. Furthermore, supervised practice using this model could be conducted during the OJT phase. It is strongly recommended that training on data integration be developed and included in the program for new recruits.

3.5.4.4 Prediction - Prediction of future traffic situations at those VTSs where surveillance aids are on hand is fundamentally a mental process of the watchstander. In those locations where computers are available to predict and display future traffic listings, watchstanders should modify those predictions when the computer output is not consistent with other data.

As indicated in Table 10, all four VTSs include in their training programs material on the characteristics of the waterway, basic shiphandling, and other information which is needed to perform the task of predicting future traffic situations. Houston-Galveston also includes material on the characteristics of the vessels that frequent the waterway, including data on types and ramifications of cargo, maneuvering problems, and tow configurations. It is strongly recommended that the other VTSs incorporate similar training on vessel characteristics in their programs.

As in the case of integrating data from displays, the process of combining this knowledge (as well as knowledge and skills such as dead reckoning that the recruit has gained in previous assignments) is learned through experience at the VTSs. It is strongly recommended that to the extent possible, guidelines for the mental processing involved in predicting vessel location be developed and incorporated into the training program. These guidelines should be presented in the orientation period; practice using these guidelines could be conducted during OJT.

3.5.4.5 Incidents and Emergencies - The primary mission of the VTS is to prevent accidents. However, watchstanders learn to recognize potentially hazardous situations through experience on the job rather than through formal training. Additionally, although reporting guidelines are established for certain categories of unusual events, they do not universally exist at all. The point at which the watchstander typically learns to respond to a hazardous situation occurs when the problem is actually happening. It is strongly recommended that the training program include the recognition and appropriate responses (SOP) to actual and potential emergency situations as an integral part of the program.

There are several steps that are required to develop the content of such a program. The first step is to classify the major types of hazardous events that have occurred in the past or that could potentially occur. For each of these categories of events, the following steps should be taken:

a. Establish reporting guidelines for each of these categories of events.

b. Whenever possible, establish the antecedent conditions that have led or could lead to a dangerous situation.

c. Provide examples -- actual accidents, or in the case of potential problems, hypothetical events -- of typical events in each of these categories.

On the basis of this information, watchstanders should receive training in the following areas:

a. Knowledge of the guidelines on recognition of potentially hazardous events.

b. Knowledge of the sequence of activities and reporting formats (SOP) for responding to major types of accidents.

c. Practice on the recognition of appropriate responses to potential emergencies.

This training should be given to all recruits. Furthermore, practice of these skills should be required periodically (at least every six months) for watchstander requalification.

Research on training indicates that extensive practice leading to overlearning is especially important when the task is infrequently performed on the job. Secondly, research also indicates the overlearning is necessary in order to maintain performance during periods of emergency (Ref. 8). Both of these findings bear evidence to the need for repeated practice in this vital area.

3.5.4.6 Standing Operating Procedure (SOP) - SOP is the fixed and approved method for accomplishing something. As used here, the term implies further that SOP is the required procedure and that it is described in a written document having the force of standing orders, available to all personnel. SOPs differ from customary practice in that the latter is a practice which may be convenient and effective but is not formally required. Any qualified watchstander must understand and be able to perform all SOPs for his or her VTS.

In Phase I, watchstanders should be introduced to the concept and importance of SOP; they should be shown the location of SOP documents (or given their own copies); and they should be told what operations are covered by SOP. As Phase I and Phase II continue, routine SOP will be an integral part of the training topics involving these procedures, and the requisite knowledge of content and practice in the skills should be stressed throughout training.

Special attention should be given to SOP for unusual events and emergencies. These procedures are vital to the fulfillment of the VTS mission. As was noted in Section 3.5.4.5, practice in SOP for unusual events and emergencies must be provided through frequent refresher training, including as accurate simulation of the work situation as is feasible.

3.5.5 Requalification Training

Training should not stop at qualification. Requalification training for watchstanders who have been qualified earlier helps ensure that their performance remains up to standard. This requalification training should be required at least every six months and should contain the following requirements:

a. Drill on hazardous situations (See Section 3.5.4.5)

b. Vessel rides (See Section 3.6.5)

c. Performance ratings (See Section 3.7.5).

Performance ratings should be given rather than written tests. The written tests indicate whether or not the watchstander knows the material; performance checks indicate whether or not the watchstander can do the job successfully.

Performance ratings should include adherence to standing operating procedures. Experienced watchstanders who do not follow SOP should be tested to establish whether or not they know it. If they do not recall the correct procedures, they should be retrained. If they do know what procedures to follow, their superior should investigate the reasons for the deviation. If reasons for deviation are warranted, changes in procedure should be considered.

3.5.6 Watch Officer Training

Although watchstander training is the primary focus of this report, some observations about watch officer training can also be made.

The watch officers should receive the knowledge training of the watchstanders. As was the procedure at the VTSs visited, watch officers need not be expected to obtain the watchstanders' level of skill in operating the equipment. They need to know enough about the watchstander's job to assess the quality of the watchstander's performance and to recognize what should be done when problems arise.

At HOU-GAL and NOLA, the basic training for specific watch officer duties apparently consists largely of experienced officers showing and explaining the job duties to the new officers. One of the officers interviewed remarked that certain problems were discussed with him, but those problems did not arise during his training. When those problems did arise, he felt inadequately prepared to handle them. Apparently, in the case of infrequent events, knowledge that would enable the officer to deal with these problems can be lost, at least temporarily. It is recommended that recurring problems and issues that watch officers encounter should be documented in writing, as much as possible, and organized so that the problems and information related to these problems can be located quickly.

Refresher training should also be required for watch officers at least every six months. This would include drill on hazardous events (at least in a supervisory capacity) and vessel rides.

3.6 METHODS OF INSTRUCTION

3.6.1 Introduction

The types of training techniques and assessment methods used by the four VTSs surveyed are presented in Table 12. As this table indicates, the VTSs use a variety of instructional methods and training aids to help the trainee learn. Standard methods such as lectures and reading assignments are employed as well as special techniques (such as a helicopter ride).

Instructional techniques and aids to complement or supplement those currently used will be discussed in this section.

3.6.2 Use of Overview in Presentation

One simple but important aspect of a good training program is to provide an overview of what is to be learned. Each of the VTSs provides a brief tour of the operations center before other training begins. Some VTSs consider this tour to be part of the training program; others consider it as part of the orientation to the VTS. Additionally, recruits at HOU-GAL and NOLA are encouraged (but not required) to observe watchstanders and listen to their transmissions whenever the trainees have free time during their orientation period.

TABLE 12. CURRENT TRAINING AIDS FOR WATCHSTANDER TRAINING AT FOUR SITES

	HOU-GAL	NOLA	PS	SF
Initial tour of VTS	X	X	X	X
Slide presentation on VTS		X	X	X
Lecture/instruction	X	X	X	X
Reading assignments		X	X	X
Programmed text	X			
Channel and industry slides/ videotapes	X	X	X	?
Maps, charts	X	X	X	X
Chart tests	X	X	X	?
Videotapes on selected equipment		X		
Equipment operation (pre-OJT):				
• Practice with computer system	X	X		
• Tape recorder to practice radio transmissions			X	
• Practice on plotting board	X	NA	X	NA
Vessel rides	(12)	(12)	X	(24)
Shore facilities visits	X		X	X
Helicopter flights over area	X	X	X	X
Observe watch	X	X	X	X
Perform watch	X	X	X	X

It is recommended that this initial tour be expanded so that watchstanders spend several hours in the operations center early in their training. This tour would include receiving an overview of the operations and a detailed explanation of watchstander activities while observing experienced watchstanders. The purpose of this extended tour is to provide the trainees with contextual framework for understanding the relationship between the initial learning (which takes place largely outside the operations center), and the actual job. This has an added advantage of providing motivation for the trainees to learn the required material. This extended tour should take place after the lessons on Local VTS Organization and Operation.

For the same reasons -- understanding the contextual framework and motivation to learn -- trainees should be provided an overview of each segment of training before that lesson begins. For example, each of San Francisco's written lesson plans used in the introductory period begins with a lesson title, a one sentence synopsis of the lesson, and the training aids used. This type of overview should also be provided for each lesson plan concerning skills as well as those concerning knowledge.

3.6.3 Study Materials

For knowledge training, the VTSs primarily rely on written material supplemented by lecture and discussion. Houston-Galveston uses a programmed learning format for their printed matter while the other VTSs use a standard manuscript format. In programmed learning, a brief presentation of information is followed immediately by one or more questions on that material. Programmed instruction is strongly advocated by training experts for two major reasons:

a. It requires active involvement of the learner.

b. It provides immediate feedback about the quality of the trainee's response.

Learners are told the "correct" answers right away, and can compare their response with the preferred answer.

A large number of studies have demonstrated the values of programmed instruction for transmitting facts and concepts quickly. To reduce the time required for training, it is therefore strongly recommended that a programmed learning format be used for the presentation of information.

It is recognized that the preparation of a programmed learning text requires more time than preparation of standard reading materials. It demands that the program designers decide specifically what they want the trainee to learn. Based upon this, program designers then write the text and develop questions related to that text. By contrast, the printed material currently in use by the VTSs in this study (other than Houston) does not seem to have been edited as rigorously. New Orleans, in particular, needs to edit its printed materials to reduce extraneous data.

It is well known that one picture is worth a thousand words. The VTS materials dealing with the equipment typically include a labeled diagram accompanying the description of the console and of other aspects of the equipment. However, in some cases the labels are too small, too faint or otherwise illegible. In some cases diagrams are not included at all, although the material clearly would be enhanced by an illustration. It is recommended, therefore, that clear, legible diagrams or illustrations be prepared in those cases in which information such as locations on the waterway or equipment features are discussed.

In the interviews, some watchstanders mentioned that the computer manuals and other materials were not up to date. (Outdated computer abbreviations were cited most often.) It is recommended that materials given to new recruits be reviewed periodically to insure that trainees are not taught information that is no longer correct.

3.6.4 Aids to Memorization

Learning important aspects of the waterway is a massive undertaking. The sheer number of features watchstanders are required to know -- in correct order along the waterway --is formidable. In addition, watchstanders are expected to develop both a two-dimensional, schematic view of the waterway and a three-dimensional concept as it actually exists. Houston-Galveston and New Orleans offer a variety of aids to help watchstanders in their memory task. These VTSs suggest, but do not require, that trainees use these aids. They very correctly -- from a learning standpoint -- allow trainees to choose those methods and aids that they find most useful. The aids for memorizing the waterway currently used at these two VTSs are as follows:

a. Maps and charts;

b. Lists of items to be memorized -- for example, reporting points -- which the trainee reads (NOLA); or fills out (HOU-GAL);

c. Slides (unlabelled) of the waterway (HOU-GAL); video-tape of the waterway with labels and narration (NOLA);

d. Chart tests -- the trainee fills in the material to be learned on blank charts that schematically portray the waterway;

e. Vessel rides;

f. Observing the computer display;

g. Flash cards of specific features of the waterway (suggested, not provided by the trainer).

We recommend another aid to be added for this memory task. This aid would consist of color, aerial slides or videotape of the waterway. These slides or videotapes should be prepared so that:

a. Two sets of slides or videotapes are prepared -- one with the features to be memorized labeled and one with those features unlabeled;

b. The unlabeled slides or videotape include a picture of the corresponding portion of the computer display; and

c. There is a hard copy version of the unlabeled set of slides or portions of the videotape.

Trainees would view the labeled slides or tapes as often as needed to familiarize themselves with the features to be memorized. To check their progress (and as a respite from passive viewing) the trainees could view the unlabeled version and record on the corresponding hard copy the indicated features. The trainees should repeat this process of viewing the labeled version, of viewing the unlabeled version and marking the hard copy as many times as is necessary to learn the waterway.

3.6.5 Vessel Rides

Each of the VTSs studied require trainees to take vessel rides. These rides serve several purposes: to aid in learning the geography of the waterway, to provide information on how to navigate the waterway, to further the process of becoming acquainted with the pilots, and to increase the understanding of the pilots' needs and problems (including dealing with the VTS).

At HOU-GAL, the first vessel ride is scheduled as early as the first week of training. The trainee is generally accompanied by an experienced watchstander, who

explains activities on the vessels and features of the waterway. At NOLA, the first vessel ride is scheduled after the trainee begins OJT. The trainees take maps along on the ride to help them become familiar with the waterway. At both HOU-GAL and NOLA, the trainees make a trip report after the ride. Additionally, at both locations, the trainees are expected to learn from conversations with the pilot.

It is suggested that prior to the trip the trainee be briefed on what he or she should attend to on the trip. For example, the purpose of any early trip may be to acquaint the recruit with particular features on the waterway. A purpose of a later trip may be to familiarize the watchstander with particular problems facing the pilot on that portion of the waterway. San Francisco provides an example of such a briefing: for each required vessel ride, that VTS provides a short information sheet, which includes questions about features of interest along with answers to those questions. Finally, a trip report should follow the ride. Additionally, before taking the first ride, the trainee should be briefed on what to say and what not to say to the pilot (and when to talk and when not to talk to him).

It is also suggested that the vessel rides should not be scheduled too early in the program; the first vessel ride should take place only after the trainee has some knowledge of the waterway through using other memorization aids and after the training segment on seamanship has been completed.

3.6.6 Computer Training

The processes of computer training during orientation period at HOU-GAL and NOLA are similar; the content of the program at NOLA appears to be more comprehensive and decidedly more structured than at HOU-GAL.

At NOLA, the trainees first read about the equipment and how to operate it. The trainer explains and demonstrates how to operate the equipment, which the trainee practices. Using a script, the trainer then role-plays vessels calling in, and the trainee keys the computer terminal to search for the vessel. (These are test vessels corresponding to those in the script. Data on these vessels have been entered into the computer for training purposes.) If the reporting (test) vessel is not one previously entered into the system, the trainee describes the procedure of obtaining data from the vessel. Finally, the trainee obtains some practice entering test vessels into the computer.

At both locations, practice on the computer is primarily data retrieval; practice on data entry is limited because the training consoles are on-line and thus training data will appear on active sector displays. Typically, test vessels entered into the system are placed in open water. The appropriate sectors are notified when practice on entering data occurs.

In earlier interviews (Ref. 7) and in the follow-up interviews, watchstanders agreed that input and retrieval of data are easy processes to perform and learn. The difficult tasks are to key the computer terminal at an appropriate speed and to integrate computer operations with other tasks that are performed simultaneously. To develop the two latter skills takes considerable practice. It is strongly recommended that the Coast Guard insure that future computer systems include an off-line training console so that extensive training and drill in computer operations can be conducted before the trainee is assigned to the operations center.

In the interim, both computer-generated VTSs could reduce the time required for an operator to get up to standard on the keyboard and reduce the number of errors that would have been made in actual operating situations by providing more practice time on data entry and retrieval during the orientation period. Following NOLA's example, this could be done by having the trainee retrieve data on test vessels that previously have been entered into the system, and to the extent possible without interfering with operations, enter new test vessels into the computer.

NOLA's procedure regarding equipment practice prior to OJT offers an appropriate model that could be adapted to the program at HOU-GAL. At NOLA the trainees first work with the computer alone. This is followed by a combination of computer training and a type of communications training. (It should be noted that the computer and transceiver are the only equipment at NOLA, whereas the HOU-GAL complement includes radar, CCTV, plotting board and miniboard.) At NOLA, the trainee practices giving traffic summaries while the trainer role-plays vessels in the system from a script that is correlated with test vessels entered in the computer. In this manner, the mental and motor skills of responding to different types of vessel reports or inquiries could be practiced.

It is strongly recommended that computer instruction and practice be structured, and that substantial practice on the computer be provided in the Phase I program. This training should be followed by combined computer/communications practice in the pre-OJT period. The suggested minimum training time for practice on the computer and combined computer/communications practice is about six to eight hours. (Because of the difficulty in estimating training time requirements owing to individual differences in learning ability and prior experience among trainees, these and subsequent training times are merely rough estimates.)

3.6.7 Communications Skill Training

All four VTSs require the watchstander recruit to observe the behavior of experienced watchstanders in the operations center as part of the training program. This technique seems to be particularly useful in the case of communications training. It exposes the recruit to the range of vessel and VTS reports and may well be an indispensable part of the training program.

Puget Sound also uses what they call a Communications Simulator. This simulator consists of two tape recorders (one with earphones) and tapes of actual vessel transmission (from which the VTS portion has been deleted). The trainees listen, over the earphones, to the vessel transmissions. Concurrently, on second (blank) tapes, they record their responses. After taping, the instructor critiques the tapes.

It is recommended that other VTSs incorporate this type of simulation training in their programs. The trainees could practice requesting information as well as giving traffic advisories. In preparing an advisory, the trainees could obtain the required data from prepared traffic sheets. The trainer should review the tape with the trainee for accuracy, adherence to standard procedure, and diction.

At NOLA and other sites where understanding local accents and terminology is a problem for new recruits, the training aid outlined in Section 3.5.4.1 could be employed. Briefly, trainees would have a typed transcript to follow while listening to tapes of actual vessel transmissions. This would help the trainees learn the local terminology as well as the local dialect.

While the three communications training methods discussed — observing the watch, practicing giving advisories with a tape recorder and listening to tapes of actual vessel transmission — are optional, it is strongly recommended that communi cations skill training of some type be included in the pre-OJT phase. It is further recommended that the time for skill practice using training aids such as those mentioned above be no less than six hours.

3.6.8 Simulation

Simulation for training involves having trainees practice operations with equipment and/or procedures that imitate the operation for which they are being trained. Skills connected with ongoing operations may be effectively taught on training simulators. There is an element of safety, also, in simulation; for it eliminates the risks involved in putting unskilled operators on-line in OJT. Simulation permits the instructor to control events for more effective training. Controlled presentation allows the instructor to:

a. Sequence problems from less to more difficult.

b. Introduce a whole range of problems in a short time, including situations that rarely arise in operations, particularly emergencies.

c. Repeat the problems that are more difficult to learn as often as necessary until the skill is acquired.

Simulation may cover a single piece of equipment (such as a radar console), a complete subsystem (such as communications), or a complete operation (such as VTC). It is highly recommended that simulation be considered in any on-site program at all levels, but particularly at the total system level. Periodically the entire system (people and equipment) should be exercised together in simulations of emergencies and

excessive traffic loads to assure that all personnel are maintaining knowledge and skill in critical SOPs.

A summary statement on simulation for training, based on a review of over 200 complex experiments with man-machine systems (Ref. 10), is reproduced in Appendix B.

3.6.9 Program Content and Instructional Methods

A matrix of the recommended program content and training aids for Phase I Training is presented in Table 13. The purpose of this chart is to indicate at what point the instructional methods might be most effectively used. In this table, instructional techniques that are recommended for a particular topic are marked with an "R"; optional aids are indicated by the letter "O".

3.6.10 Sequencing

The effectiveness of any training session may vary depending on how much and what training has preceded it ... that is, on the trainee's readiness for that learning experience. Consideration of readiness in planning the sequence of training sessions is well worth the effort, since it will pay off in the long run in a more efficient, less time-consuming program. There are certain similarities as well as differences among the VTSs in the order in which the material is currently presented. Some regularity occurs simply because logic dictates a specific order; some diversity exists because of the unique characteristics of the waterways and the individual VTSs. Additionally, some diversity exists because in certain cases the order of presentation is not important; in those cases, the point at which the topic is included is a matter of convenience.

TABLE 13. MATRIX OF RECOMMENDED PROGRAM CONTENT AND TRAINING AIDS

PHASE 1

	Programmed text[1,2]	Vessel rides	Observe watch	Practice on equipment	Other aids
Introduction to VTS:					
• VTS history and purpose	R				
• VTS organization and operations	R				
Local VTS Organization and Operation					
• Local VTS Mission and responsibilities	R				Slide/video tape on VTS (R
• Local VTS organization and operation	R				Tour of operations center 4 (0)
• Local VTS policies and procedures	R				
• Applicable laws, rules and regulations	R				
• Coast Guard area commands	R				Site visits (0)

1. In addition to text, lecturer is available to answer any questions.
2. Lecture and discussion, with reading assignments or reading assignments with instructor to answer questions are optional alternatives to programmed text.
3. Where applicable.
4. Includes observation of watch.

TABLE 13 (CONT'D)

	Programmed text[1,2]	Vessel rides	Observe watch	Practice on equipment	Other Aids
Waterway					
• Geography of the waterway	R	R			Maps, chart tests, slides/ videotape of waterway (R); flashcards, site visits (O)
• Local industries and facilities	R	R			
• Local waterway laws and customs	R	R			
• Traffic Separation Scheme[3]	R	R			
• Traffic lights[3]	R	R			
Traffic					
• Channel/port operations	R	R			Site visits (R)
• VTS vessel characteristics	R	R			
Seamanship					
• Applicable rules of the road	R	R			
• Basic ship handling	R	R			

TABLE 13 (CONT'D)

	Programmed text[1,2]	Vessel rides	Observe watch	Practice on equipment	Other Aids
Communications					
• System and equipment	R	R			
• Operating procedures for VTS radio	R	R			"Communications simulator" (R)
• Bridge-to-bridge radio telephone procedures	R	R			
• Local terminology and accents	R	R			Tape recordings of vessel report (O)
• Interpretation	R	R			
Vessel data cards[3]					
• System and equipment	R	R			
• Operating procedures	R	R			
Plotting board[3]					
• System and equipment	R	R	R		
• Operating procedures	R	R	R		
• Interpretation	R	R			

TABLE 13 (CONT'D)

	Programmed text[1,2]	Vessel rides	Observe watch	Practice on equipment	Other Aids
Computer[3]					
• System and equipment	R		R	R	
• Operating procedures	R		R	R	
• Interpretation	R		R		
Radar[3]					
• System and equipment	R		R		
• Operating procedure	R		R		
• Interpretation	R		R		
CCTV[3]					
• System and equipment	R		R		
• Operating procedures	R		R		
• Interpretation	R		R		

TABLE 13 (CONT'D)

	Programmed text[1,2]	Vessel rides	Observe watch	Practice on equipment	Other Aids
Integration and prediction					
• Integration	R		R		
• Prediction	R		R		
Incidents and emergencies					
• Recognition	R				
• Response	R				
Standing operating procedure					
• Routine SOP	R				
• SOP for emergencies and unusual events	R				
Supplementary equipment					
• System and equipment	R		R		
• Operating procedures	R		R		

TABLE 13 (CONT'D)

	Programmed text[1,2]	Vessel rides	Observe watch	Practice on equipment	Other Aids
Preventive maintenance of equipment	R		R		
Forms, reports	R				
Safety and security procedures	R				
Standard references	R				

1. In addition to text, lecturer is available to answer any questions.
2. Lecture and discussion, with reading assignments or reading assignments with instructor to answer questions are optional alternatives to programmed text.
3. Where applicable.
4. Includes observation of watch.

Basically, the sequences currently used by the VTSs are appropriate. The VTSs seem to be following the principle of building upon earlier learning. That is, they present the requisite knowledge before introducing skill training which builds upon that knowledge, and present simple concepts and processes before the complex.

A suggested sequence for those areas for which a desirable order exists is described below. This sequence is based upon evaluation of order of presentation from a training viewpoint. In general, the order in which the topics are listed in Table 13 is the basic order in which the topics should be presented. Topics such as Forms, Reports and Message Handling Procedures or Safety and Security Procedures, however, can be included at any point in the program. Furthermore, memorization of the waterway may be interspersed with lessons on Traffic, Seamanship and the knowledge portion of the Communications Training. This serves to reduce the monotony and frustration which sometimes results from memorization tasks. For HOU-GAL, there is no recommendation as to whether the radar or TV should be presented first.

More specific recommendations are as follows:

a. The extended tour of the operations center should follow the lesson on Local VTS Organization and Operations (See Section 3.6.2).

b. The first vessel ride should take place after the lessons on Traffic and Seamanship, and only after the trainee has some knowledge of the waterway obtained through the use of other memory aids (See Section 3.6.2).

c. Before the first lesson on communications, the trainee should spend several hours in the operations center observing the watch.

d. For each piece of equipment, the trainee should first read how to operate

it, then be shown how to operate it and practice operating it before learning about the next piece of equipment.

e. Skill training should proceed by the progression method: the trainee practices one part at the first session. Then, at the next session, a second part is added and both parts are practiced together. The addition of parts continues until the whole skill is learned.

3.7 GUIDELINES FOR MANAGING ON-SITE TRAINING

3.7.1 Introduction

This section addresses several issues related to the management of on-site VTS training. In the interest of control, efficiency and uniformity of training, the appointment of a training officer is strongly recommended, and functions and qualifications for this position are developed (3.7.2). Two techniques that will shorten training time -- full utilization of Phase I training and formulation of structured guidelines for OJT -- are proposed (3.7.3 and 3.7.4). Current training programs take more time than is necessary. This is particularly critical, because excessive training time reduces the useful operational time in a watchstander's VTS tour (typically about two years). This section also notes the importance of establishing performance standards and regularly testing progress and proficiency against these standards, both before and after qualification (3.7.5).

3.7.2 Responsibility for Training

At HOU-GAL and NOLA, pre-OJT training is conducted by one set of persons and training in the operations center is conducted by another set. An inevitable by-

product of this division of responsibilities is that there are discrepancies between what is taught in the initial phase and what is taught in OJT. Having one person responsible for the entire training program would eliminate this problem. Furthermore, to restructure the content and organization of the training program as recommended in this document would call for a person with some background in training.

It is strongly recommended one training officer be made responsible for both the initial training and OJT. This person's responsibilities would be as follows:

a. Manager of training.

b. Training designer.

c. Trainer of trainers.

As manager of the training function, the training officer would perform all functions any manager does. This means planning, organizing, directing, controlling and evaluating the training operation.

As a training designer, the training officer should be responsible for:

a. Defining training needs.

b. Analyzing these needs in terms of training requirements and objectives.

c. Designing programs to achieve those objectives.

d. Developing evaluation procedures.

As trainer of trainers, the training officer should be responsible for training the enlisted personnel who will actually do the training.

The minimum qualifications in terms of knowledge and skills this officer should have for the responsibilities as training designer and as trainer of watchstander-instructors are as follows:

a. Basic learning theory.

b. Task analysis.

c. Behavioral objectives.

d. Training techniques, including Job Instruction Training (the basis for OJT).

e. Program evaluation.

The training officer can be expected to have exposure only to the fundamentals in each of these areas, rather than detailed knowledge and experience. Basic training concepts can be acquired through courses in training offered at many universities or through workshops offered by one or the professional training associations, such as the American Society for Training and Development. It is recommended that the officer responsible for training at least know the basic principles in the above-mentioned areas.

3.7.3 Phase I Training

As indicated in the description of the current programs in Section 3.3.3, the training at these VTSs is primarily OJT. There are several disadvantages to OJT:

a. OJT tends to be more time consuming than alternative training methods.

b. Operating personnel do not necessarily have the skills or the motivation for teaching.

c. Training activities may present a distraction or hazard to the extent that they interfere with on-going operations.

d. The trainee/instructor ratio is low, which tends to make high cost.

Certain skills can only be obtained and developed through experience in the actual job environment. Accordingly, OJT must be part of any VTS qualification training program.

All VTSs studied do conduct a certain amount of training in an initial (pre-OJT) training period. The advantages of such pre-OJT training includes:

a. The order of instruction may be varied to achieve the most effective training sequence without jeopardizing normal operations.

b. The skills to be developed can be carefully structured so that undesired or unnecessary skills can be eliminated from the instructional process.

c. The training is the primary task of the instructor; his attention is not diverted by operational tasks.

d. A one-to-one relationship is not required for all instruction. (For example, the trainee can practice communications skills using the suggested aids without being continuously monitored.)

e. Provision is made for all recruits to learn a common core of knowledge and skills.

f. Special training aids can be used to facilitate learning.

For these reasons, it is strongly recommended that as much training as possible be conducted during the initial training phase. Indeed, all the knowledge components of the watchstander's job and as much skill training as possible should be presented in Phase I. Furthermore, since repeated practice is necessary to learn complex skills, as much practice in the skill areas as possible should also be included in this phase.

Several of the watchstanders interviewed mentioned they had noticed reduction in skill level from the initial training period to application in the operations center. This dropoff could be reduced considerably if the trainee received more practice on that skill in the initial training period.

3.7.4 Guidelines for OJT (Phase II)

There are no written guidelines for OJT at HOU-GAL or NOLA. Although the watch officers (or watch supervisor) provides general guidance and supervision of OJT, there is no set procedure. The content and method of instruction is, by and large, left up to the experienced watchstanders who are actually doing the training.

It is quite possible that some watchstanders are better trainers than others. In other OJT situations, it has been found that experienced workers may show the trainee all the possible ways to do the job, instead of just the best or most efficient way to do it. A more serious problem exists when the instructor knows how to do the job, but not in the most effective way. Additionally, some watchstanders interviewed stated that they did not like to train new recruits. It may be that they might like this task better as they felt more competent as trainers.

It is strongly recommended that the following guidelines for watchstander OJT be prepared:

a. A detailed breakdown and effective sequencing of tasks to be learned.

b. Methods of instruction.

It is strongly recommended that watchstander trainers be instructed as to how to carry out these guidelines.

The breakdown of the operations should include the steps involved in performing each of the tasks involved in the watchstander's job. It should also include the sequence in which the tasks should be taught. This analysis should be performed by a person with a training, human factors or similar background with experience in job analysis.

Conducting the breakdown is a time-consuming process. The benefits, however, are concrete and long lasting:

a. It generally saves training time because the most efficient way of doing the job is identified and presented.

b. It insures that everything that should be taught is included.

c. It insures that the activity is presented in a systematic manner.

A by-product of this process may be improvement in SOP through the identification of unnecessary steps or inefficient ways of operating.

As mentioned in Section 3.6.2, before instruction on any new lesson begins, the instructor should give an overview of the lesson, telling the trainees what they are to learn and the main steps in the operation.

Most well-designed OJT programs use a "show and tell" approach to instruction. For watchstander training, the general sequence of instruction for each task could be as follows:

a. Instructor performs the activity.

b. Instructor describes what he/she did, stressing the key points, and answers trainee's questions.

c. Trainee performs the activity (under supervision).

d. Trainee describes what he/she did.

e. Instructor asks questions, corrects errors.

f. Trainee continues to practice this activity (under supervision).

Obviously, if the trainee has problems, one or more of the steps would be repeated.

Additionally, instructors should be advised that it is as important to praise the trainee for correct performance as it is to correct errors. Praise not only provides feedback to the trainees that thay are doing an activity correctly, but gives them confidence in their ability to perform the job.

3.7.5 Assessment of Progress

The VTSs consider assessment of trainee's progress to be important. As mentioned previously, preliminary and final written tests of knowledge are given in the initial training period; preliminary and final performance checks are made in the OJT phase.

At HOU-GAL and NOLA, written tests of knowledge of the waterway or other information are administered almost weekly during Phase I, and a final test in writing is given at the end of the pre-OJT period. During OJT, the trainees periodically are formally rated on their performance and are given a final performance rating when they seem to have learned the job.

By informing the trainees of their progress, feedback from these tests and performance checks serves to monitor learning and to motivate the trainees. Furthermore, feedback provided to qualified watchstanders on their performance helps to insure good performance after training is completed.

It is recommended that written performance standards be prepared for all watchstander tasks for all VTSs. These standards should include not only the kinds of tasks the watchstander is to accomplish, but as far as possible, the specific behaviors and required level of behavior to meet those standards. The development of these standards is desirable for the following reasons:

a. Essential to establish the level of proficiency required for performing the task.

b. Useful in diagnosing a trainee's specific learning problems.

c. Essential for identifying performance deficiencies in watchstanders who have been qualified for duty.

d. Necessary to demonstrate fairness; that all watchstanders at a VTS are evaluated against the same benchmark.

It is further recommended that watchstanders' performance be periodically measured against these standards. For recruits, measurement may well be taken weekly; for experienced watchstanders, every six months.

3.8 RECOMMENDATIONS FOR ON-SITE TRAINING

The following recommendations are made based upon analysis of available information from the various sites. Recommendations are rated as to priorities as follows: strongly recommended, and recommended.

1. Currently, training at the VTSs visited is primarily on-the-job training. One major drawback with OJT is that it takes longer than necessary. The major recommendations that would address this issue are as follows:

   a. Assign responsibility for the entire training program to one person who shall have education in the field of training. (See Section 3.7.2) (Strongly recommended.)

   b. Increase the length of the pre-OJT training period to include:

      1. All knowledge training.

      2. As much skill training as possible.

      3. As much practice of skills are possible. (See Section 3.7.3) (Strongly recommended.)

   c. Prepare detailed guidelines for OJT and train the watchstander-trainers on these guidelines, which should include:

      1. A detailed breakdown and sequencing of tasks to be learned.

      2. Methods of instruction. (See Section 3.7.4) (Strongly recommended.)

2. Training or important cognitive skills should be incorporated in the training program for watchstanders. Lessons should be provided in the following areas:

   a. Interpretation of each of the available displays. (See Section 3.5.4.2) (Recommended.)

   b. Integration of data from displays. This lesson should be based on data provided by a detailed examination of the integration process. (See Section 3.5.4.3) (Recommended.)

   c. Prediction of vessel location, including lessons on:

      1. Vessel characteristics.

2. The process of integrating relevant information. (See Section 3.5.4.4) (Strongly recommended.)

d. Recognition and response to unusual events. (See Section 3.5.4.5) (Strongly recommended.)

3. Recommendations on training techniques and aids to be added to the VTS complement are as follows:

a. Develop and use programmed text for imparting information. (See Section 3.6.3) (Strongly recommended.)

b. Provide overview of training:

1. Extended tour before training begins.

2. Brief overview before each new lesson. (See Section 3.6.2) (Recommended.)

c. As an aid for memorizing the waterway, provide color, aerial slides or videotape of the waterway -- one set with the features to be memorized labeled and one with those features unlabeled -- and a hard copy version of the unlabeled set (See Section 3.6.4) (Recommended.)

d. Provide structure to the vessel ride and assign first ride only after lesson on seamanship. (See Section 3.6.5) (Recommended.)

e. At those centers with computers, provide computer training that offers:

1. Structured instruction and practice.

2. Substantial skill practice in pre-OJT phase.

3. Combined computer and communications practice (See Section 3.6.6) (Strongly Recommended.)

f. Provide communications training in the following areas:

1. Modeling correct performance by observing experienced watchstanders.
2. Practicing transmissions using two tape recorders and tape of edited vessel tranmissions.
3. Listening to tape of actual transmission for comprehension.

(See Sections 3.5.4.1, 3.6.7) (Use of communication aids strongly recommended.)

4. Prepare detailed, written performance standards couched in behavioral terms and measure performance against these standards. (See Section 3.7.5) (Recommended.)

5. Require requalification training at least every six months, which includes activity in the following areas:
   a. Drill on unusual events. (Strongly recommended.)
   b. Vessel rides (Recommended.)
   c. Performance ratings (See Section 3.5.5) (Recommended.)

6. Watch officer training should include the following subjects:
   a. Basic -- though abbreviated -- watchstander training.
   b. Written, indexed guidelines to recurring problems.
   c. Refresher training, including participation in practice on emergency situations and vessel rides. (See Section 3.5.6) (Recommended.)

4. RECOMMENDATIONS

4.1 RECOMMENDED ACTION

4.1.1 Recommendations for Selection of VTS Watchstanders

a. Reject assignees for VTS duty who:

1) Fail to meet basic physical fitness criteria,

2) Have unsatisfactory service records, or

3) Are strongly opposed to a VTS assignment.

b. Do not undertake the development and standardization of a battery of pyschological selection tests for VTS duty.

c. Consider converting the MCAT to a Caost Guard format for use as an initial screening test.

4.1.2 Recommendations for Training VTS Watchstanders

a. Continue efforts to establish a VTS watchstander resident training course (see Section 3.4).

b. Promulgate formal guidelines for the conduct of on-site VTS training. Use Section 3.8 of this report as a guide to the structure of an on-site training program; Section 3.5 for specification of course content; Section 3.6 for guidance on training methods, and Section 3.7 as a guide for training management.

4.2 RESOURCES

The recommendations in Section 4.1 are based primarily on selection and training considerations. Although an attempt has been made to quantify costs and benefits of

the selection options (Section 2.5.3), data are inadequate to permit such an evaluation of the training programs. The authors realize that implementation of some of the recommendations may not be possible due to restrictions in available personnel and

funds. In some cases, proposed details have been scaled roughly (such as from "highly recommended" to "optional") or preceded by the word "consider" as aids when choices must be made. However, in the end, only the on-site VTS commander and staff can determine which of these recommendations are desirable or feasible.

Nevertheless, the authors agree that the selection and training of VTS watch-standers warrent a greater and more systematic effort than is currently being made and offer this proposed program as a goal. If the realities of resource restrictions prevent full implementation of these recommendations, the Coast Guard's aim should still be to come as close as possible to the goal.

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APPENDIX A

CONCLUSIONS AND RECOMMENDATIONS

FROM THE VTS ISSUE STUDY (REFERENCE 1)

VII G CONCLUSIONS

1. Criteria for Selection of Personnel

a. Experience

1) Watch supervisor

- o Lieutenant - minimum
- o Three years experience as deck watch officer on a medium or high endurance cutter - minimum.

2) Sector controller

- o Quartermaster and radarman rates only
- o Chief petty officer as senior controller
- o Second class petty officer minimum grade for controller.

b. Personal qualifications

1) Articulate. Ability to communicate will be of significant importance to the successful prosecution of the VTS duties.

2) Mature, stable, sober. There will be times where the emotional stability of these individuals will be tested under stress conditions. Their actions might well result in the difference between successful passage of vessels or a collision.

3) Background knowledge

- o Rules of the road
- o Tides and current
- o Aids to navigation
- o Anchorage regulations
- o Plotting procedures
- o Radiotelephone procedures
- o Radar operation.

Much of the above background knowledge will be brought to the duty station with the individual assigned. In those areas where the individual is deficient, on-the-job training can be accomplished.

2. Training Requirements

a. On-the-job training

The most important aspect in ensuring the availability of a well-qualified VTS watchstander or watch supervisor is a well-structured on-the-job training program adopted to the local area. To accomplish this, training billets must be established.

The VTS billet structure should reflect the fact that for every four operational billets, a fifth billet will be necessary to provide for a continuous state of training new personnel. This is based upon the assumptions that a tour of duty in the VTS system will be of three years duration and that replacement personnel will have a degree of qualification upon their arrival. The nature of this duty is unique to the Coast Guard and a three to four month training program will be required before an individual can be considered a "qualified" VTS watchstander.

b. Advance training

The Maritime Institute of Technology and Graduate Study collision avoidance radar course should be utilized. The value to the Coast Guard will be well worth the cost. The MARAD radar courses should be utilized as part of the on-the-job training program.

c. Long range training program

The immediate training needs for VTS watchstanders can be met by on-the-job training, however, there is a sufficient number of standardized requirements that a consolidated training course at a permanent location will be a requirement for the future.

VII H. RECOMMENDATIONS

1. Thorough pre-selection screening should be normal practice in selecting personnel for VTS operating units.

2. The need for a comprehensive pre-reporting course at a permanent station should be re-examined. In the meantime, a minimum of two officers per year should attend the radar collision avoidance course at the Maritime Institute of Technology and Graduate Studies.

3. Recognition of the special qualifications needed by VTS watchstanders should be established through the qualification code system.

4. Incentives for pursuit of VTS duty should be established by a proficiency pay program.

5. VTS planners should utilize the experience of FAA traffic system planners, managers, watch supervisors and controllers in those areas which are common to both the air and vessel traffic systems.

APPENDIX B

COMMENTS ON SIMULATION

FROM PARSONS (REFERENCE 10, p. 551-552)

Systems and subsystems in various configurations can be improved by functioning in exercises during which operators at their regular positions and equipment respond to inputs which are simulations. Such system training involves both the enhancement of interactive and individual skills and the development of interactional procedures, the relative contribution of each to system improvement being yet undetermined. The effectiveness of system training stems from a combination of feedback about performance, including knowledge of results, and discussion of procedures among team members; the relative contribution of each of these to system training is also undetermined.

Untrained system personnel may be grossly unprepared, lacking knowledge, skill, and procedures. System training can bring system performance to a level well above that which the system reaches without it.

A subsystem can be trained by itself if the inputs it would receive in real life can be properly simulated (which is not always feasible). By putting two subsystems into the same training exercise, however, the inputs to one are the outputs of the other, thus obviating the need for special simulation, and the interactions between them can be practiced and procedurized as well.

Remote subsystems and operators need to be included in system training if their performance is important to system functioning and if the rest of the system receives their outputs or they receive the system's outputs. Subsystems at the sensors (front end) of some systems fit this category, as do those among the effectors.

System training is particularly needed when a system first begins operations (or beforehand) and when novel situations arise, although it may be helpful also in maintaining performance at a desired level. For it to counteract the effects of turnover of

personnel, apparently turnover must not reach the point where the skills acquired through training are steadily diluted.

System or team training seems to be of special benefit to "invisible" functions, where an operator is unable to determine the consequences of his actions during operations.

When operators process information in series, practice seems to help the first operator in the series in particular, at least at first. Until his error rate drops, the others fail to receive the error-free high rate input which will require better performance. Each gets more training when the one preceding him is trained to a high performance level. The same phenomenon occurs with the training of subsystems which operate in series. One index that the whole team or system is well-trained is the absence of any interaction between serial position and load.

To cope effectively with high input loads, teams and system must practice with such loads. If loads are progressively increased, it is likely that system output will also increase, but this does not necessarily mean that teams should always be trained by progressively raising the input loads. Constant high-load practice, at least under some circumstances, can be even more helpful than practice of equivalent duration in which loads progressively increase.

Team or system training which presents simulation inputs to operators at their system positions is not the only kind of training which improves performance. Initial practice with as highly abstracted simulation of the system can be beneficial. Individual training is also needed, and it may be an even better preparation for tasks which also involve a modest amount of interaction between operators than training which includes the interactions; the interaction requirement may interfere with learning that part of the task centered on individual performance.